



**A PRIMARY CARE WORKLOAD PRODUCTION MODEL
FOR ESTIMATING RELATIVE VALUE UNIT OUTPUT**

THESIS

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Abstract

Health care costs have grown to unsustainable levels nationally and within the Department of Defense (DoD). Since military health care costs have historically been difficult to identify, leaders often use budget cuts as their vehicle for cost control. Maximum efficiency is thus the resulting strategy in order to show progress. With its new preventive health plan, the Family Health Initiative (FHI), the Air Force aims to establish a long-term posture for more cost reduction through prevention. Therefore, the goal of this research effort was to develop a tool to help decision-makers understand and improve efficiency in health care workload output. Specifically, this thesis sought to establish whether a relationship exists between patient workload demand and the per-encounter variables collected at the Wright-Patterson Air Force Base Medical Center (WPAFBMC) Primary Care Clinic. This study examined primary care production data from the Military Health System Management Analysis and Reporting Tool (M2) from fiscal years (FY) 2009 and FY 2010, which documented 162,610 encounters and measured the patient workload in Relative Value Units (RVU) per encounter. The resulting model, with an adjusted R^2 value of 82%, indicates that the Appointment Type variable explains a significant amount of the differences in RVU output per encounter. Therefore, the model is considered a demand-based predictive tool for RVU production. Its use could lead to a better understanding of the potential for managing efficiency in the Primary Care production of required patient throughput.

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Table of Contents

	Page
Abstract	iv
Acknowledgements	v
List of Figures	ix
List of Tables	x
Chapter I: Introduction	1
Preventive Medicine	6
The Air Force Family Health Initiative	9
Problem Statement	12
Research Objectives	13
Methodology	13
Assumptions and Limitations	14
Significance of Study	15
Purpose of Remaining Chapters	15
Chapter II. Literature Review	17
Primary Care	17
Relative Value Units	20
The Fiscal Cycle and Health Care Budget	27
Relevant Study	30
Incentive to Save	31
Fragmentation of Information	32
Cost Management through Efficiency	34

	Page
The PCMH Concept	35
The National Demonstration and Other PCMH Projects	37
The Air Force’s Family Health Initiative	39
<i>Staff Reengineering</i>	40
<i>Managerial Inclusion</i>	42
Summary.....	43
Chapter III. Methodology	45
Multiple Linear Regression Model Development	45
<i>Step 1: State the Research Hypothesis:</i>	47
<i>Step 2: State the Null Hypothesis:</i>	47
<i>Step 4: Calculate the Regression Equation from the Data</i>	53
<i>Step 5: Examine Measures of Association and Tests of Statistical Significance</i>	55
Chapter IV. Results and Analysis.....	58
Variables	58
Variables Considered and Set-Aside	60
<i>Simple RVUs</i>	60
Variables Considered for Model Inclusion.....	63
Variable Analysis	68
Data Analysis.....	70
Regression Model	72
Summary.....	79
Chapter V. Conclusions.....	80

	Page
Discussion and Conclusions	80
Research Summary	80
Regression Model	81
Model Strengths	85
Model Limitations.....	85
Recommendations.....	87
Future Research	88
Future Related Subject Areas.....	89
Conclusion	91

List of Figures

	Page
Figure 1. Total National Health Expenditures Calendar Years 1960-2009 (Adapted from CMS, 2010).....	2
Figure 2. Operations and Support Budget Projections through 2028.....	3
Figure 3. History of Medicare Conversion Factors (Adapted from AMA, 2010)	23
Figure 4. Standard Slope Formula (SAS, 2010)	54
Figure 5. JMP© Fit Y by X (JMP©, 2010).	55
Figure 6. JMP© Scatter Plot: Enhanced RVU Output per Encounter vs. Patient Age....	69
Figure 7. Distributions Enhanced RVUs.	71
Figure 8. Cook’s Distance Overlay Plot	76
Figure 9. Distributions Residual Enhanced Work RVUs	78
Figure 10. Monthly Enhanced RVU Output FY 2009 & FY 2010.....	84

List of Tables

	Page
Table 1. E&M Codes for Services Performed in an Office or Other Outpatient Setting (Adapted from CMA, 2010)	22
Table 2. General Formula for Calculating Medicare Payment Amounts (Adapted from AMA, 2010).....	24
Table 3. Wright-Patterson Medical Center Annual RVU Production Requirements	27
Table 4. Beneficiary Category Statistics per Encounter at WPAFBMC (FY 2009- FY 2010)	65
Table 5. Provider Specialty Codes	66
Table 6. WPAFBMC Primary Care Most utilized E&M Codes (Adapted from AMA; CMS, 2010).....	67

A PRIMARY CARE WORKLOAD PRODUCTION MODEL FOR ESTIMATING RELATIVE VALUE UNIT OUTPUT

Chapter I: Introduction

Growth in health expenditures per capita in the United States (U.S.) has outpaced that of the nation's Gross Domestic Product (GDP) since the 1940s (Bureau of Labor Statistics, 2010). Total health care services costs have risen on average by 4.5% annually in the past decade (BLS, 2010). Similarly, uniform quality regulations and standardized management and care practices have increased in scope and scale; affecting all care systems' costs to a greater degree. There has thus been a major push in the healthcare industry to compete for patients by controlling costs and improving quality and financial positions through a more efficiency-minded health network. As a result, a new preventive health care model has taken hold in the civilian health care sector: the Patient-Centered Medical Home (PCMH).

The military health care network is not immune to competing for patients, expectations of efficiency, or cost increases. Coupled with the grim economic circumstances and war on two fronts, the U.S. government has requested that military health care costs be better tracked and controlled. While measures have been put in place by the DoD for itemization and fiscal accounting of some care components, the services use the same cost accounting methods and dollar amounts applied by Medicare billing, without actual cost data driving their numbers. Moreover, the DoD has been unable to well-articulate or justify their health care funding intensity to congress' satisfaction.

Military health care managers face the additional fiscal constraints levied on services in the public sector. Escalating health care scope and scale have meant the traditional range of military medical needs has expanded as well. Consequently, the military health care budget has distended ad infinitum along with that of private health insurance, Medicare, and Medicaid.

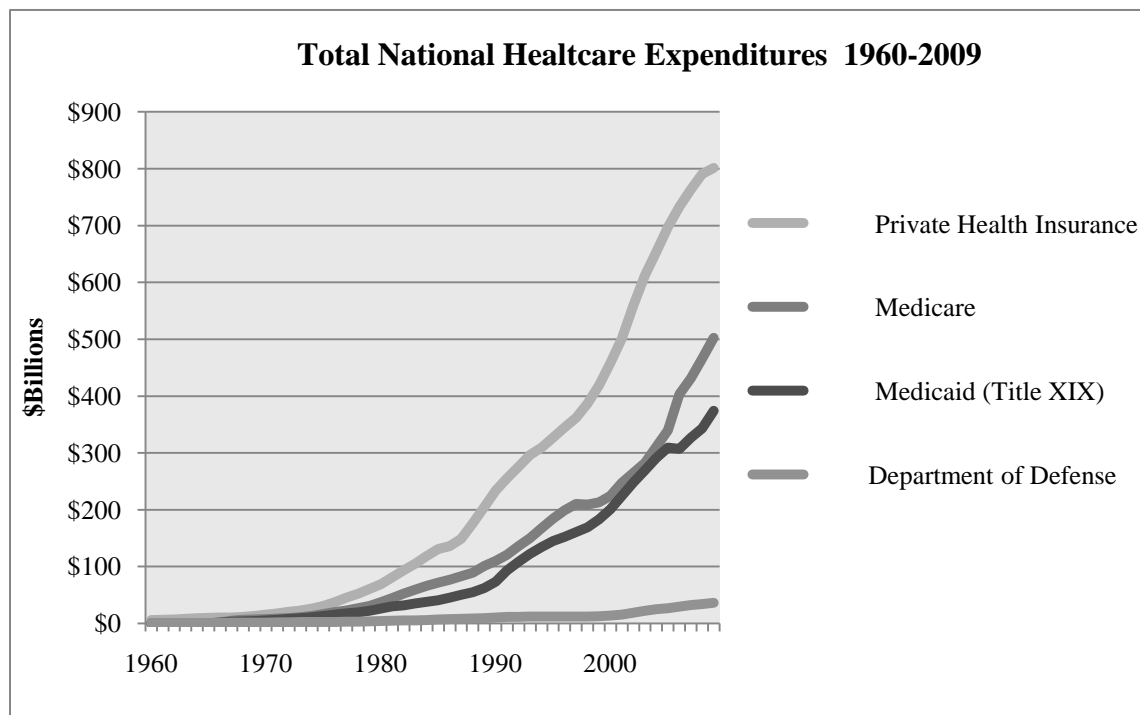


Figure 1. Total National Health Expenditures Calendar Years 1960-2009 (Adapted from CMS, 2010)

Given the historical cost growth, the military expects continued expansion of its health care outlays as a percentage of the total Operations and Support budget (Congressional Budget Office, 2010).

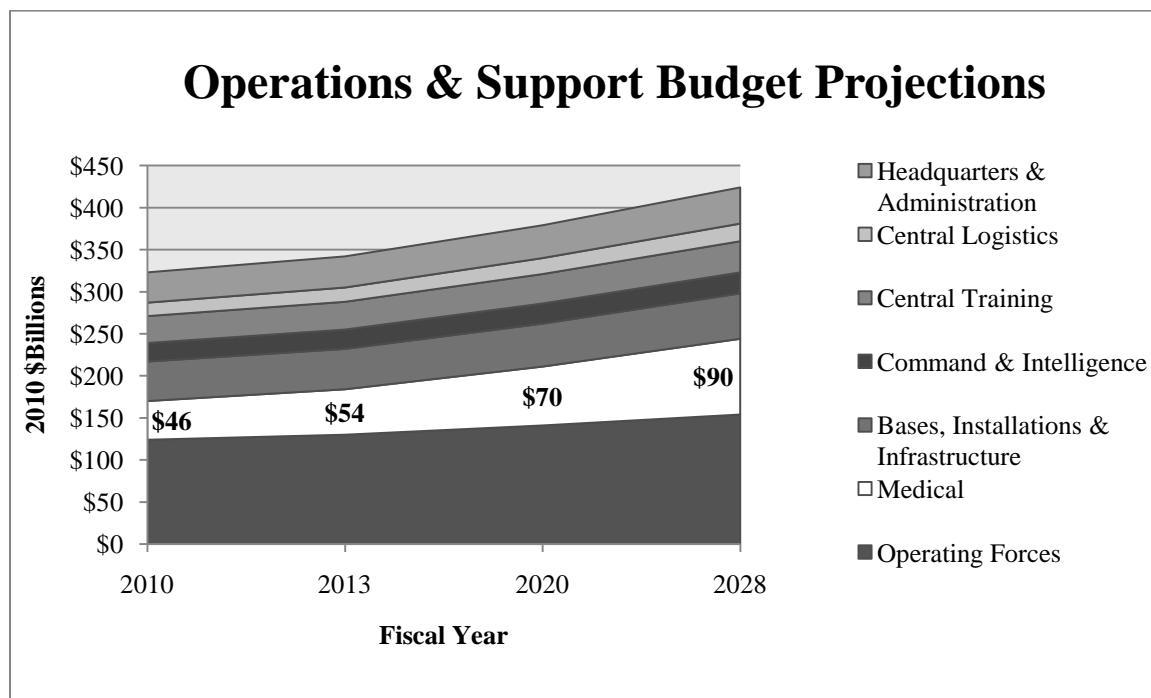


Figure 2. Operations and Support Budget Projections through 2028. (Adapted from the Congressional Budget Office, 2010).

Background

The Air Force is currently implementing the tenets of the PCMH model in the hopes that quality and access to care will improve, while increasing efficiency and reducing long-term health care costs. The results of this thesis study show, however, the current methods of output prediction are not tied to the demand presented by the patients, but rather, the production capacity based on historical work output. The effects of such methodology can mean unexplained workload fluctuations related to the reengineering effort could cause the Air Force to falter in its output commitments.

Historically, the economic complexities of delivering health care in any system have caused the scope of cost drivers to be unclear and difficult to measure. Each major factor's contribution to health cost rises and how they interact with the others has been the source of great debate. There exist many lesser factors that could arguably comprise a significant portion of costs; however, there is agreement about the main areas that contribute the most to cost growth. The key areas commonly cited include technology, society and its related demographics, insurance plan scope and administration, governmental and regulatory mandates and fraud (Cutler et al., 2001).

More widespread use of new technologies in the U.S. has been argued to be the most significant area for increasing healthcare costs, perhaps contributing as much as 50 percent of the total rise (Cutler & McClellan, 2001). Chronic illness costs, however, were shown to constitute approximately 75 percent of all U.S. health care spending (USDHHS, 2010). Chronic illnesses encompass various harmful personal habits in society such as smoking, heavy drinking and obesity. Such habits are shown to be the largest contributors to chronic disease (USDHHS, 2010). Expected to exacerbate cost increases, the largest generational cohort known as the "Baby-Boomers", born from 1946 to 1964, has increased the population's overall average age (Smola & Sutton, 2002; Kaiser, 2009). This trend has and is expected to continue to increase medical costs, in that patients 65 and older have a higher average expenditure per person due to age-related disease prevalence (Kaiser, 2009). Health insurance has also grown in scope, resulting in premium costs that have outpaced inflation and worker compensation. As a result, American patients have paid less of their total health care bill since Medicare began in

1965, causing a gap between the cost of services rendered and the portion of services paid for (Kaiser, 2009).

Government and regulatory mandates, while difficult to quantify in terms of costs, also heavily affect health care delivery. One study estimated that the economic impact of health care regulation on the U.S. economy accounted for approximately \$169 billion in 2004 (Conover, 2004). This amounted to costs of over \$1,500 per household that year. The Patient Protection and Affordable Care Act of 2010 is expected to further increase health care oversight costs (Centers for Medicare and Medicaid Services, Office of the Actuary, National Health Statistics Group; and U.S. Department of Commerce, Bureau of Economic Analysis and U.S. Bureau of the Census, 2010). Health care fraud also accounts for a considerable portion of health care costs in the U.S. The Federal Bureau of Investigations (2007) contends that “fraudulent billings and medically unnecessary services billed to health care insurers” are becoming progressively more complex and are estimated to be between 3 and 10 percent of total health care expenditures.

While the factors contributing to healthcare cost increases are myriad and complex, the healthcare community has agreed a reformation of the current system is necessary to stem costs. In 2009 health care costs were expected to comprise 17.3 percent of GDP (Truffer et al., 2010). To conceptualize this magnitude, the U.S. GDP was estimated at over \$14 trillion in 2009 (CIA, 2009); therefore, 17.3 percent of the GDP would equate to \$2.422 trillion; or just over \$7800 for every person living in the U.S. (CIA, 2010). At the DoD, health care spending grew at an average annual rate of 16 percent: from \$17.4 to \$35.4 billion in the period from 2000 to 2005, while prescription drug spending more than tripled (Government Accountability Office (GAO), 2010).

From Fiscal Year (FY) 2005 to FY 2010, the DoD healthcare budget jumped by over 60 percent to about \$50 Billion (Department of Defense, 2010). This equates to about \$5200 per beneficiary (TRICARE, 2010).

The same 2010 GAO report showed that TRICARE for Life was the source of 48 percent of the cost increase during the period. TRICARE for Life began managing military health care coverage for those over age 65 in 2001(GAO, 2010). According to the GAO, military health care inflation contributed 24 percent of all military cost increases from 2000 to 2005, while the Global War on Terrorism contributed just 6 percent (GAO, 2010).

Preventive Medicine

The medical community has recently thrown their support behind the PCMH model as perhaps the necessary programmatic vehicle for the reformation of health care delivery, reimbursement practices and primary care's importance, as well as long-term health care cost rises (Nutting et al., 2008). The PCMH concept is not new, as some of its principles were introduced by the American Academy of Pediatrics (AAP) in 1967. The U.S. government recently supported the initiative, by creating a United States Preventive Services Task Force (USPSTF). Through the Department of Health and Human Services (DHHS), USPSTF provides information about preventive medicine. The DHHS website asserts:

“Too many Americans don’t get the preventive health care they need to stay healthy, avoid or delay the onset of disease, lead productive lives, and reduce health care costs. Often because of cost, Americans use preventive services at about half the recommended rate. Yet chronic diseases such as heart disease,

cancer, and diabetes – which are responsible for 7 of 10 deaths among Americans each year and account for 75% of the nation’s health spending – often are preventable” (U.S. Department of Health and Human Services, 2010).

Preventive care programs have received a high level of attention because, as Cohen, Neumann & Weinstein (2008) discuss, nearly 40% of all possible causes of death in the U.S. are potentially preventable. Within this population, they argue:

“some of the measures identified by the U.S. Preventive Services Task Force, such as counseling adults to quit smoking, screening for colorectal cancer, and providing influenza vaccinations, reduce mortality either at low cost or at a cost savings” (USPSTF, 2008).

Yet their study of nearly 1,500 cost effectiveness ratio analyses showed that “sweeping statements about the cost-saving potential of prevention, however, are overreaching” (Cohen et al., 2008). For instance, the authors cite how increases in the number of patients screened for a low-incidence disease will far outweigh the costs of any treatment avoided by such a small portion of patients who would have become ill in the absence of treatment. The majority of the existing preventive care cost studies focus on cost control and Return on Investment (ROI) of initiatives aimed at specific chronic diseases or a portfolio of screening and prevention initiatives, rather than holistic programmatic expenditures. When a broader programmatic estimate is taken, the general consensus is that the PCMH concept is initially costly.

Implementation of the recent PCMH principles in dozens of states has enjoyed unusually strong support from a wide range of sources. These sources include “employers, insurers, state and federal agencies and professional organizations” (Nutting, et al., 2008). Davis, Schoenbaum and Audet (2005), leading members of a sponsor to the

National Demonstration Project (NDP) evaluations, have proposed a set of characteristics of the PCMH concept which have shown to hold up under demonstration.

- Superb access to care
- Patient engagement in care
- Clinical information systems that support high-quality care, practice-based learning and quality improvement
- Care coordination
- Integrated and comprehensive team care
- Routine patient feedback to doctors
- Publicly available information

As implementation of the comprehensive PCMH concept is so recent, military leaders' energies have been aimed at quality and improving the patients' treatment outcomes.

Costs have been relegated to a distant, more long-term theory. While the cost realm is acknowledged widely as an unexplored shortcoming of the PCMH program, it has only been recently that some new theories on cost-related models and model transformations have begun to emerge in scholarly studies and journals.

One understudied area of concern involves the staffing and programmatic delivery effects related to the changes in how preventive care is delivered under the PCMH concept. Preliminary benchmark reports on medical practices that were either chosen as national study subjects or local pilot projects have only recently been published. In the *Initial Lessons From the First NDP*, evaluators reported how the early PCMH transformation period requires adequate financial resources to implement the necessary information technology (IT) and operations and maintenance (O&M) pieces (Nutting, et al., 2008). While such reports discuss a general initial increase in costs for the practices,

notably absent are definitive discussions of the maintenance of, improvements in or effects on efficiency.

The Air Force Family Health Initiative

In 2008, the Air Force began implementing its service-wide PCMH program called the Family Health Initiative (FHI) in its Family Practice clinics. The FHI program was conceived in response to patients' concerns about seeing their assigned Primary Care Manager (PCM) consistently and with better access to appointments. For the first time, eligible patients showed their dissatisfaction by responding to a survey with a result of less than a 50 percent rating for their "Would You Recommend a Friend?" metric (Kosmatka, 2010). The survey also showed that the Air Force medical staff had the same desire for consistently caring for their own patients (Kosmatka, 2010). Staff concerns included building better continuity of care, the need for adequate and consistent support staff and a patient panel size that allowed the practice of consistent, quality medicine. To improve, they asked for greater control of their own practices (Kosmatka, 2010).

The FHI strategies mandate that components of Air Force Primary Care services evolve to come in line with the Patient Centered Medical Home (PCMH) concept.

Specifically, the Air Force PCMH concept holds four tenets:

1. Physician-led team
2. Availability of 90 appointments per week
3. Cross-booking by exceptional circumstance only
4. Time managed by the provider and/or the team

Reengineering of the Air Force Primary Care Clinics will include many changes meant to achieve “Medical Home” status, such as: staff and role reorganization, appointment schedule and template revisions, new and better access to care metrics, changes to the way medicines are ordered, IT system updates, protocol development, establishing baseline scores in several new metric areas and updated nomenclature (Kosmatka, 2010).

Of the 13 sites who had implemented the FHI strategies by the end of 2009, only Scott and Andrews AFBs reported cost containment (Air Force Times, 2009).

Efficiency is only addressed insofar as how an increase in available patient appointments has caused patients to respond positively. Further, while costs are stated as one of four core Military Health System “aims”, per-capita metrics are not collected or reported within the individual MTFs (Air Force Times, 2009). In his April 2010 address to the House of Representatives’ Committee on Armed Services, Surgeon General Green illustrated the complex nature of the military health system by highlighting its sometimes competing mandates and multiple stakeholders:

“By increasing volume complexity and diversity of care provided in Air Force hospitals, we make more care available to our patients; and we provide our clinicians with a robust clinical practice to ensure they are prepared for deployed operations, humanitarian assistance and disaster response (Green, 2010).”

The FHI program is, in a sense, an unfunded mandate requiring resources be expended in order to achieve the tenet goals. Because public funding lags its requirement, implementation of the FHI may, in fact, change the amount of funding available to cover the costs of present commitments (GAO, 2004). Military health care administrators and managers have some latitude in modifying the scope of care and schedule offered in a particular MTF, in order to affect efficiency. As of yet, however, there has been little

guidance for them to aid in predicting the effects of the FHI mandates on their budgets and resources. Metrics following the costs of the new model's effects on efficiency are not being collected, reported or formally released.

One area of the FHI that is more well-defined involves the changes to the staffing model. Work production-related analyses of the FHI strategy effects will become increasingly important in lending clarity to and justification of a different mix of Air Force health care resources. Establishing an early, concrete focus on changes related to production throughput for the PCMH implementation is crucial if cost control, and later cost reduction, is to be achieved. The related metric measures being considered do not include changes the FHI policies may affect in the underlying demand for care. Relinquishing the opportunity to establish and track current efficiencies without considering patient demand will cause a future failure for the Air Force to monitor and gain control of those components that drive production demand for their Family Practice Teams.

The GAO has produced several recent studies that question whether free health care for the military and its retirees is sustainable, due to such reports as that from the Quadrennial Defense Review (QDR): "military health care costs have increased substantially in recent years" and "budgetary projections for the next several years suggest that costs will continue to rise by more than 6.5 percent annually" (QDR, 2008). Thus, Defense Secretary Robert Gates supports fee increases for some and mandated initiatives to develop efficiency (Miles, 2011). Military health care managers will consequently be challenged to analyze and explain which variables affect their programs' production and costs, in order to oversee the reengineering of resources in the most

efficient manner. The constricted nature of the Air Force's resource pools necessitates that commanders, managers and FHI policy implementers gain clarity of the FHI's programmatic effects in order to make fiscal choices that avoid broad, uncontrolled production fluctuations.

Problem Statement

Because the patient-centered medical home concept reengineers the primary care delivery system, and a number of preventive care programs have been shown to increase medical costs, the Air Force must ensure fiscal conscientiousness is a component of the FHI concept of operations (CONOPS). FHI guidance, however, has not included formal evaluation on its effects outside of existing efficiency measures. CONOPS provide the “operational context needed to examine and validate current capabilities, and may be used to examine new and/or proposed capabilities required to solve a current or emerging problem” (Defense Acquisitions University, 2010). Moreover, reorganization under the FHI mandates includes a rigorous alteration of clinical staff teams, which could alter production.

The Air Force has aimed at moving to PCMH-like care models in the past, and Air Force Medical Operations Agency (AFMOA) guidance on historical programmatic weaknesses notes that flaws in “lack of accountability” and “metrics that did not drive the desired behavior” were major stumbling blocks to the success of these programs (Kosmatka, 2010). This research effort attempted to set the groundwork for baseline patient demand-related production analyses on primary care in order to provide

information clarity to managers and decision-makers looking to find the most efficient use of resources available.

Research Objectives

The main research objective of this effort was to evaluate the impact of patient demand variation on work production unit outputs. To do this, the following research questions attempted to answer:

1. What analytic tools and methodologies are currently utilized to analyze and predict production data?
2. Do the per-encounter variables of age, gender, beneficiary category, provider specialty, appointment type, month and E&M code show statistically significant relationships with the output of RVU's in primary care?
3. What type of variation do these variables impose on work production output (RVUs) in primary care?
4. Which variables are predictive of RVU output?
5. What analytic tools or methodologies could be created to analyze, predict and present cost and production data?

Methodology

The methodology in this study primarily consisted of a literature review of the national and state-level PCMH projects and Air Force policies to establish the work production concerns during FHI implementation. A panel of health care decision-makers, managers and subject matter experts at the WPAFBMC was consulted to answer question number one. This research relied on data, managerial and policy insight gained

through consultation with the panel members who execute the hospital budget, analyze and control costs, manage resources, plan and strategize FHI program implementation and primary care staffing practices in answering questions two, three and four. The values gained through this analysis were then applied to a Monte Carlo simulation to produce a statistically supported model which can be useful in predicting monthly work production RVUs for 2011 and answered question five.

Assumptions and Limitations

An assumption was made in this research that the medical data provided were accurate, complete, and applicable to future costs and production. Additionally, it was assumed that existing information from electronic Air Force Knowledge Exchange communication channels is accurate and complete. Current primary care staffing allowances and actual levels would remain the same from FY 2009 to FY 2011, which may not be the case in the event a team member is deployed, away for training or personal reasons. An assumption was made in this research that subject matter expert opinions and experience used are generally current, unbiased, accurate and complete, exclusive of documentation to the contrary. Finally, an assumption was made regarding probabilistic independence in per-encounter data analysis in that no one event has an effect on the probability of another event occurring.

A limitation of this study is that the data analyzed is based on historical documents and that the patient population and underlying system will remain similar in going forward. We know this will not be the case, as the patient population is ever-

changing and somewhat able to be maneuvered through managerial oversight. Moreover, the FHI program essentially changes the care production landscape. Another limitation of this study could lie in the fact Air Force budget and resource levels are not stable in many instances, and cannot be relied upon to remain within a stated confidence range. This is due to the asymmetrical realities of military service. Therefore specific manning levels were not addressed directly, but an assumption was made that a similar future production capacity will be possible, as in the period studied.

Significance of Study

The academic body of knowledge concerning fiscal PCMH implementation effects is limited. The body of knowledge for publicly-run health care PCMH implementation is further limited. This study seeks to begin scholarly work in this area to fill that gap. Air Force program managers are unsure what the FHI mandates could add or subtract from their efficiency capabilities. To date, no related studies have been accomplished to analyze current work production outputs before FHI implementation in an effort to understand those affects. This research effort establishes a statistically sound method of predicting work production output through patient demand variables.

Purpose of Remaining Chapters

The remainder of this thesis presents subsequent chapters for a literature review, methodology, results and analysis, as well as conclusion and recommendations. Chapter II's literature review will present an assessment of the relevant current writings pertaining

to the FHI and WPAFBMC costs and production. Chapter III will discuss the methodology used to analyze the data, and Chapter IV will summarize results of the data analysis. Finally, Chapter V will discuss recommendations and suggestions for related future research.

Chapter II. Literature Review

The purpose of this chapter is to present what is known about the Patient Centered Medical Home (PCMH) model and the Family Health Initiative (FHI) strategies that the Air Force is using to meet the model's goals. This chapter also details how these strategies are being applied to provide care at Wright Patterson Air Force Base Medical Center (WPAFBM), and what implications they may have for care production. Recent national PCMH implementations have been so swift and robust that vital conversations required in order to hone, share and include the best benchmark ideas are only now occurring between the first-movers. Only in the past year, for instance, have results from the first demonstration projects been collected, examined and presented for public consumption, yet dozens of health care entities have moved to adopt its principles. The situation has not allowed health care leaders to answer difficult questions such as: what is the existing relationship between PCMH care production and costs, and what is proper in going forward? This literature review is meant to lend context to the production efficiency challenges that may face a public health care institution during a large-scale reengineering of health care delivery.

Primary Care

Inspection of medical cost growth over time has shown that health care systems that center their delivery around primary care have produced better overall quality and population health, as well as lower costs (Stange et al., 2010). Primary care has historically been a physician and practice-centric entity, and few have been inclined to

use a hospital-wide team approach to delivering care. The Air Force medical service sees a similar care environment rife with a physician-centered approach, yet with the added factors of military authoritarian cultural norms and a large, bureaucratic system that often forces innovation to wait. While not unique to the military or primary care, the way in which military health costs are approached depends largely on the time and resources necessary for physicians to treat patients. It is no wonder, then, that the PCMH concept has taken hold handily as a means to restructure the now fragmented way in which primary care affects its patients.

A 2007 analysis of primary care costs, based on the current classification system for health costs, shows that primary care only accounts for approximately 6-8 percent of total spending for personal health services; in the form of payments to primary care physicians (Goroll, Berenson, Schoenbaum & Gardner, 2010). Arguably, that percentage grows far larger when considered in respect to the effects primary care has on the outcomes of such costly portions as chronic diseases. The Air Force and WPAFBMC are addressing that very issue in adding further disease management (DM) nurses to their staff. Initially, the function was conceived as a primary care process, and perhaps disease management will eventually be considered similarly. However, WPAFBMC managers have had to face the reality that the fragmented nature of existing primary care delivery has placed patients who require disease management with all manner of specialty physician for a primary care manager (PCM). Thus the disease management portion of their implementation will mean, at least initially, patients are not confined to primary care.

The addition of DMs is in itself potentially problematic as it relates to health care costs and efficiency. This is because the DMs are an added PCMH cost that would otherwise not have happened. Further, the DM goal is to manage patients with chronic diseases better so that fewer visits and less physical severity during the visits are achieved. According to the subject matter experts consulted, moving some of the current primary-care related visits from specialists who might otherwise see patients with more robust medical needs should theoretically place care again where it belongs, increase primary care demand, and allow for some increase in the specialty physician's production.

However, if the DMs are able to reduce necessary care for patients with a disease that must be managed, the overall effects of the DMs should lessen the facility's actual and potential output, while imposing additional salary costs of \$200,000 annually (SalaryExpert, 2011). Such a scenario, while a tenet of the PCMH concept and the right goal for health care givers, may alter their ability to meet their required work production output through the current RVU-related measures, which is discussed in more detail in the Relative Value Units section. Resource managers are confident their patient demand is robust enough to make-up for any work production RVUs lost through disease case management, however, they are currently working to identify how these impacts will manifest themselves. This is the case, they argue, because there are eligible enrolled patients who cannot or do not get an appointment with their primary care provider, and instead use a civilian physician in the network. It is assumed these patients can be brought back into the network through efforts to open the schedules further.

One tenet of the FHI involves ensuring patients are seen by the same provider each time they need to be seen; termed “continuity of care”. This concept is such a central principle of the PCMH that the Air Force has made it a mandatory piece of the FHI. According to Air Force guidance, active duty patients will be placed with their primary care physician, while patients in other categories are mandatorily placed with an outside provider if there is not an appointment available. Further, the FHI’s rework of the staffing model means teams at WPAFBMC have gone from ten members to two members responsible for seeing patients. More discussion about this concept follows in the Family Health Initiative section.

Relative Value Units

The same primary care billable costs mentioned in the 2007 study above are tracked and analyzed by Air Force health care administrators. They do this by electronically coding each type of patient appointment and type of ailment. Since 2003, military health care managers have used the RVU system set forth by the Medicare Physician Payment Schedule to categorize and track production as well as bill patients for costs of care. While active duty care is not charged to the patients, care is charged in some instances for retirees and other eligible patients, thus a bill is itemized and presented to TRICARE for payment for each patient encounter. The RVU system is a common accounting standard used in the DoD healthcare community. RVUs are composed generally of the cost value assigned to physician’s work, their practice expenses (or overhead) and liability insurance. The value of RVUs per encounter is

based on the amount of time a provider spends with their patient. This time is classified by a weighted system of Procedural Terminology (CPT) Evaluation & Management (E&M) codes assigned electronically as the patient is seen. Specifically, CPT E&M codes are broken into patient categories that delineate whether that patient is new or established.

Table 1 includes guidance put forth by the American Medical Association (AMA) on the most widely utilized CPT E&M code descriptors. The AMA's explanation of how these codes are determined:

“The descriptors for the levels of E&M recognize seven components, six of which are used in defining the levels of E&M services. The first three components (history, examination, and medical decision making) are considered the key components and are required in selecting the appropriate level of E&M services. The next three components (counseling, coordination of care, and the nature of the presenting problem(s)) are considered contributory factors and while important, they are not required to be provided during each patient encounter.”(AMA 2010)

“It is important to note that there is a significant time variance between consultation codes and office visit codes that the physician typically spends face-to-face with the patient according to AMA CPT coding guidelines. Time descriptors in CPT E&M guidelines are averages and, therefore, coding should depend on the actual clinical circumstances. “The use of time may be considered the key or controlling factor to qualify for a particular level of E&M services.” (AMA, 2010)

“As noted, AMA has determined through extensive survey and analysis that consultative services require more physician work, including extensive documentation, testing, and written communication back to the referring physician of the patient's health status. Further, it is common for coordination of services and counseling to dominate the consultative patient encounter (services provided in outpatient, hospital floor/unit, and nursing facility settings). Therefore, physicians should familiarize themselves with AMA CPT coding guidelines for using “time” when 50 percent or more of the visit is spent on counseling and/or coordination of care (CMA, 2010).

Table 1. E&M Codes for Services Performed in an Office or Other Outpatient Setting
(Adapted from CMA, 2010).

Coding Guidance New Patient (Requires all three key components)	Coding Guidance Established Patient (99212-99215 require two of three key components)
99201 <ul style="list-style-type: none"> • Problem focused history • Problem focused examination • Straightforward medical decision making Typical face-to-face time 10 minutes	99211 <p>For the evaluation and management of an established patient, that may not require the presence of a physician. Usually, the presenting problem(s) are minimal. Typically, 5 minutes are spent performing or supervising these services.</p>
99202 <ul style="list-style-type: none"> • Expanded problem focused history • Expanded problem focused examination • Straightforward medical decision making Typical face-to-face time 20 minutes	99212 <ul style="list-style-type: none"> • Problem focused history • Problem focused examination • Straightforward medical decision making Typical face-to-face time 10 minutes
99203 <ul style="list-style-type: none"> • Detailed history • Detailed examination • Medical decision making of low complexity Typical face-to-face time 30 minutes	99213 <ul style="list-style-type: none"> • Expanded problem focused history • Expanded problem focused examination • Medical decision making of low complexity Typical face-to-face time 15 minutes
99204 <ul style="list-style-type: none"> • Comprehensive history • Comprehensive examination • Medical decision making of moderate complexity Typical face-to-face time 45 minutes	99214 <ul style="list-style-type: none"> • Detailed history • Detailed examination • Medical decision making of moderate complexity Typical face-to-face time 25 minutes
99205 <ul style="list-style-type: none"> • Comprehensive history • Comprehensive examination • Medical decision making of high complexity Typical face-to-face time 60 minutes	99215 <ul style="list-style-type: none"> • Comprehensive history • Comprehensive examination • Medical decision making of high complexity Typical face-to-face time 40 minutes

For billing purposes, the dollar value of each RVU does not change necessarily from year to year, and is not tied to inflation. The value is adjusted based on the

“Medicare economic index, an expenditure target “performance adjustment” and miscellaneous adjustments including those for “budget neutrality”” (AMA, 2010).

The historical RVU Medicare Conversion Factors have fluctuated from -5.4% to 5.4% during annual adjustments, however the 2009 adjustment was 5.3% lower than the prior year, while 2010 remained stagnant (Figure 3).

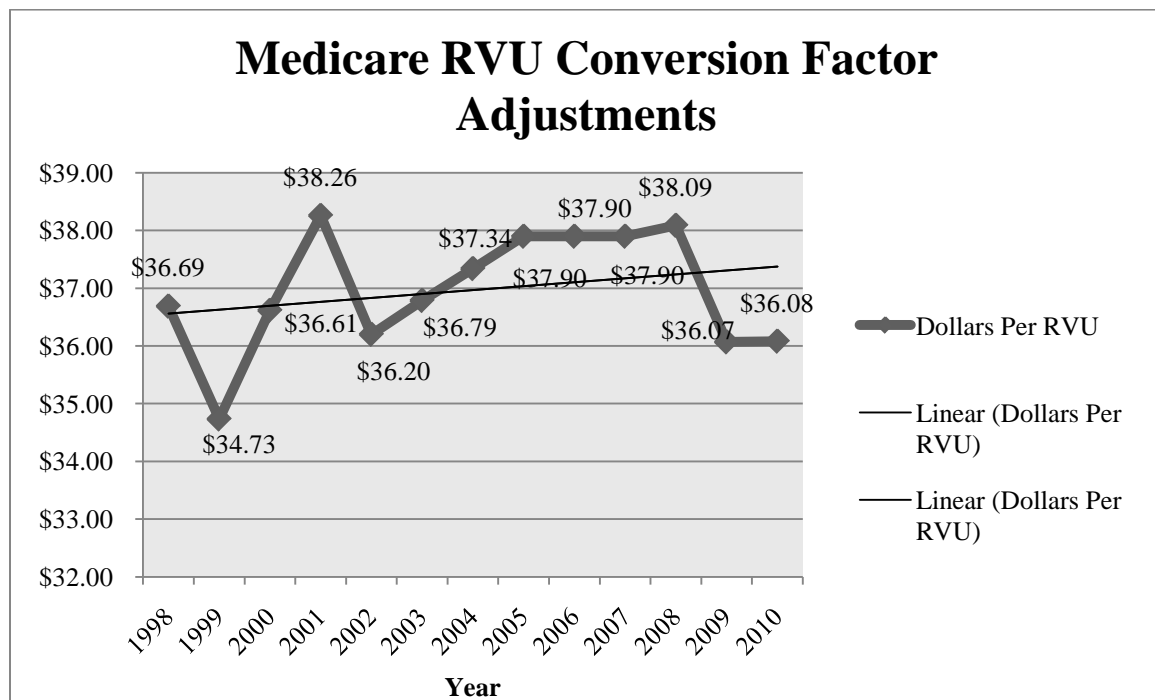


Figure 3. History of Medicare Conversion Factors (Adapted from AMA, 2010)

To calculate payment amounts using the Medicare system, the practice expense, malpractice insurance and RVUs are each adjusted by a geographic practice cost index (GPCI); that total is then multiplied by a conversion factor in a separate dollar amount. This is the amount billable to the patient, and is the system used by all DoD health care entities in order to account for their production. RVUs are earned entirely based on the

work of the physician (or physician's representative such as a Physician's Assistant (PA) or Nurse Practitioner (NP). PAs and NPs practice only under the guidance of a physician. The general formula for converting RVU output into billable costs is seen in Table 2.

Table 2. General Formula for Calculating Medicare Payment Amounts (Adapted from AMA, 2010).

	Work RVU x Work (GPCI)
+	Practice Expense (PE) RVU x PE GPCI
+	Malpractice (PLI) RVU x PLI GPCI
	= Total RVU
x	CY 2011 Conversion Factor of \$33.9764
	= Payment

Here, the Geographic Price Cost Index (GPCI) is used to inflate or deflate the work RVU produced, the practice expense, and the malpractice expense. In the Air Force, only work RVUs are billable costs, while practice expense and malpractice were not. Work RVUs constitute only the work produced by the physician or clinic during the care of the patient, thus the Air Force has not been compensated for the use of its facilities. Beginning in FY 2011, however, Air Force payments will include a practice expense, which compensates the service for equipment and facilities costs. Malpractice insurance is not purchased in health care provided by the DoD.

Each year, the Air Force Medical Operations Agency (AFMOA) determines the expected number of RVUs to be produced by each Air Force medical facility, based on that facility's provider staffing (Appendix A). This RVU number is also made concrete by a contractual agreement with TRICARE Management Association (TMA) to do so. If the Military Treatment Facility (MTF) hits its target, they are deemed as having met their care goals. If a MTF comes in under their RVU target, the facility leaders are questioned about their shortfall. Inability to produce the required output can affect their future funding allocations. A facility that does not meet their RVU goals can be given lesser status when monies become available for improvements and innovations, or when leaders must determine which facilities are most worthy of investment.

In order to answer the first research question, interviews with this effort's expert panel revealed there was one tool being utilized regarding the forecasting of work production output in each MTF. The tool originates from AFMOA and is based on staffing data provided through the MTF's business plan (Appendix A). This tool is a form of regression analysis which uses historical RVU output data per provider in the prior fiscal year, to project output capacity for the following fiscal year. Data from the Military Health System Management Analysis and Reporting Tool (M2 database) is pulled for every clinic in each MTF, to calculate an average RVU count per provider FTE per day. This figure is compared with the clinic's overall peer group in the Air Force. The number of encounters per day per provider is determined in order to produce a ratio of RVUs per encounter. The annual RVU capacity is then calculated by multiplying the RVUs per provider per day by that clinic's available FTE and finally by the number of work days. In order to project the available capacity for the following year, the projected

available FTEs for the clinic are multiplied by the last fiscal year's actual encounters per provider per day and the expected work days per year. The result is AFMOA's prediction for the clinic's RVU output.

This methodology, while consistently applied, is not entirely accurate in calculations of per provider efficiency in primary care, as M2 showed a number of unofficial weekend work days where RVUs were generated. This methodology for calculating efficiency ratios ignores variations in provider type, the effects of providers who do not consistently work in primary care or who work in an "unempanelled" status, nurse-generated RVUs and those who are only on the books for a short period.

One hitch in this system involves incentives: the revenue generated by the facilities through RVU's does not ultimately fall under that facility's control. In fact, monies made through RVU production do not materialize in the budget and are not a component of that clinic or MTF's financial portfolio. Thus, MTF budgets are not connected with actual costs, profits or losses generated by its clinics. Like most public entities, MTF budgetary outlays tend to be close to the prior year's actual budgetary outlays, using historical data to project similar needs in order to cover existing commitments. Likewise, the Air Force treats RVU generation potential as roughly similar to that of historical outlays. The relative incentive for MTFs, therefore, is to cleanly meet the target number of RVUs within the budgetary and other programmatic constraints.

In general, WPAFBMC has met their AFMOA-designated RVU goals. In 2011, there will be a massive jump in the RVUs given to each facility, as a credit for facility cost has been added into the calculation. After FY 2010, the Simple RVU system will be

eliminated in favor of the Enhanced RVU calculation. Table 3 provides an example of the effect this will have on overall WPAFBMC RVU production rates.

Table 3. Wright-Patterson Medical Center Annual RVU Production Requirements

Fiscal Year	Simple RVUs	Enhanced RVUs
2009	315,796	--
2010	363,417	836,657
2011	--	899,528

RVU's, as quantified in the DoD system, do not address costs related to military readiness requirements or physician's malpractice insurance. Until FY 2011, RVU's did not include an amount for the cost of practice expenses either. The notable rise in expected output is simply a recognition that these practice expenses should be accounted for. The MTFs' use of the RVU system does not project their actual costs of providing health care, but is rather a standardized system of accounting for care on a per-visit basis.

The Fiscal Cycle and Health Care Budget

In the FY 2011 Budget Request Overview from the Under Secretary of Defense (Comptroller, 2010) outlined the year's budgetary themes:

- Taking care of people
- Rebalancing the force to more effectively fight current wars
- Reforming how DoD does business; reforming what and how we buy
- Supporting our troops in the field

In most every sense, each of these themes can be applied to the problems associated with military health care cost overruns. While the health care community has its own assertions about specific reasons they believe health care costs have risen so steadily, the GAO identifies broader policy-related economic concerns: the increase in military health care spending coupled with the lack of growth in military patient's personal contributions to care, the exponential growth expected in the national health care scene, and expectations that if left unchecked, federal spending for mandatory programs will increase to over 60 percent of total budgetary outlays by 2017 (GAO, 2010). TRICARE, the worldwide health care management program serving military members, National Guard and Reserve members, retirees, their families, survivors and certain former spouses, serves a relatively large group of approximately 9.6 million beneficiaries (TRICARE, 2010). In a 2007 presentation for the Task Force on the Future of Military Health Care, Comptroller General David Walker asked whether:

- TRICARE cost-sharing requirements should be brought into parity with those of other public and private payers
- Cost sharing, including enrollment fees, deductibles, and copayments, for retirees and their dependents in TRICARE be indexed to inflation or increases in other public and private sector insurance, so that they increase over time
- Cost-sharing requirements should be designed to encourage TRICARE beneficiaries to use options that are most cost-efficient for DOD

While DoD health care cost growth is attributed to the same factors as in the civilian sector, policy-related economic causes such as those identified by the comptroller, as well as legislative and programmatic factors also contribute. Public health care institutions increasingly find their programs' scope escalating or remaining constant while they

experience resource and budget reductions. For instance, the FY 2010 budget cut of 10 percent for WPAFBMC was accompanied by the requirement to honor the existing contractual and programmatic commitments, as well as the same efficiency and patient loads. Military budget cuts have been a fact of life for many years, and such fiscal instability causes problems when managers attempt to plan for costs in the long term. Because of the intricacies of public budgeting and the constraints set on the resources provided, internal cost data, revenue from care production and actual execution of the budget are unable to be directly tied to costs.

This is because Medical Treatment Facility (MTF) budgets are funded and driven by the locally-produced annual business plans. From the business plans submitted, AFMOA then determines the RVU output requirement for each MTF and delineates them to the clinic level. Their emphasis on production output as a target, rather than customer demand as an input to computing costs was a change made in 2005; when the Military Health Service (MHS) determined to gain control of costs by funding their health care differently. The program is termed “Prospective Payment System”; originating from a similar effort by the Center for Medicare and Medicaid Services’ (CMS) in the 1980’s. Emphasis on using FTE production history to forecast production demand tends to forecast capacity, or the supply of potential RVU output, as noted in a report by Air Force Captain, Charles Moniz in 2008. While this is noted on the calculations provided from AFMOA, the number created in using this system is used as a target. Because primary care RVU production tends to have less variance than that of more specialized clinics, this system has been fairly successful. This is evidenced by the fact this study’s panel of subject matter experts confirmed the WPAFBMC is within $\pm 5\%$ of their target during

most years. Should the number of RVUs vary in any direction, however, the clinic would be at a loss to statistically explain the changes in the underlying patient demand. Rather, useful analysis might include using the characteristics of the underlying patient population to determine demand, as the patient population is ultimately the source of the potential for RVU output.

Relevant Study

In this literature review, one study was found to have strong relevance to the question of RVU production in the DoD. In this study, Moniz (2008) found through an analysis of variance that age, gender and beneficiary category were demand-related variables whose statistical variance in mean values was predictive of RVU output. Moniz (2008) used FY 2006 M2 outpatient data from Nellis AFB, Langley AFB, and Travis AFB. His analysis included patient demographic studies that had previously been statistically linked to prediction of patient demand, and accordingly, production output. The conclusions Moniz' (2008) work that confirmed patient demographic data was predictive of demand laid the ground work for further studies in this area. Yet these and other input variables are not being considered in the Air Force's calculation of RVU work production output.

Incentive to Save

Incentive to be more fiscally vigilant is not a hallmark of public sector finance. This is mainly due to the mechanism wherein managers who find innovative methods to spend less to generate the same product from one year to the next are rewarded by having their budgets cut by the amount that was saved, rather than being given incentive to save money during the year for contingencies, but ultimately spend the same amount as the prior year to maintain a budget similar in size to that of the prior year. Thus, in a general sense, public program requirements do not decline from year to year. Managers must then run their programs only paying for absolutely necessary items from the end of the fiscal year to the time budget appropriations money becomes available under Continuing Resolution Authority (CRA).

Further exasperating the problem, in all but 3 of the last 30 years, Congressional appropriations were not passed at the start of the fiscal year, but more often closer to December, with the CRA period lasting on average 3 months (GAO, 2009). Public institutions are thus asked to run operations conservatively on funding meted out “in accordance with funding formulas frequently referenced to the previous years’ appropriations acts or a bill that has passed either the House or Senate—instead of a specific amount” (GAO, 2009). While managers experienced with the “funding constraints and uncertainty” caused by the CRA process are somewhat able to moderate its effects, the GAO contends in their 2009 study that the effects of the CRA process on public agencies are unable to be completely reduced or avoided.

Fragmentation of Information

The fragmented nature of the data systems in MTFs is particularly affecting for medical services, because Air Force health care managers tend to manage budgetary issues with separate databases that keep and track data only for very specific metrics. General Practice Managers (GPMs) oversee staffing, appointment templates and patient empanelment (assignment to a specific provider) and are well versed in the direct costs associated with annual salaries for any particular member. Biometrics and statistical analysts know how the care costs are tracked and billed and craft the annual business plan. Finance and Budget personnel execute the budget. Each utilizes different data systems, which translates into a more fragmented picture of the health care cost portfolio. Staffing, for instance, is funded and hours are tracked differently for Air Force members as opposed to government civilians and contractors.

The Air Force does track physicians' work hours; however, they do not specifically track time with and time away from patients. Thus, rather than attempting to calculate a site-specific efficiency rate, an assumption is made that they spend 75 percent of their time seeing patients while government civilians are assumed to spend 80 percent of their time seeing patients. Civilian contractors do not track their hours, but rather the assumption is made the 90 percent of their time is spent in clinic with patients, due to less time spent on daily military or government-specific requirements. The entire system of costs is centered on the physician's time and effort. Even ancillary services are billed according to the amount of time a physician had to spend deciding which service to request and the follow-up required for such things as checking laboratory results. Nurses

and technicians' time is more evenly applied and is based on the number of patients and the type of ailments their physician sees. Yet the services of each of these members are not included in RVUs, except in specific circumstances such as a telephone consult conducted exclusively by a nurse.

In summary, a large disconnect exists between actual costs of health care and how the Air Force is able to apply the costs to a medical bill. This is due to several reasons. First, costs for medical malpractice insurance are unable to be applied, since the physicians themselves are not responsible for paying for their own malpractice insurance or billing their customers. Second, because costs for maintenance and upkeep of the practice's physical facilities are managed by the base services or civil engineering sections rather than the hospital, they are not collected, reported or otherwise able to be included on the bills. Recently, however, Medicare released a new RVU configuration in which an overhead amount is included in the RVUs for facility use and will be applied during FY 2011. When the MTF presents its Family Care Services bill to the TRICARE Management Association at the end of the fiscal year, there is not direct transaction; the MTF is noted as having met its production goal or not.

This generates still another challenge to incentivizing the people who are responsible for managing or providing care, in that they do not ultimately have authority over the proceeds or shortfalls of their efforts. Such issues challenge cost estimators' ability to provide real insight into how budgetary risks affect costs and efficiency. Annual budget projections for DoD health care are due months in advance of the start of the fiscal year, and during execution are not connected with actual costs.

Cost Management through Efficiency

In the 1990's Health Management Organizations (HMOs) emerged as a remedy for health care cost savings and efficiency generation. The DoD currently uses TRICARE Management Association (TMA) to manage their billing and outside provider administrative transactions. The idea of a HMO was for health care providers to focus on their core strengths, rather than trying to compete in the administrative realm, while the "experts" were able to focus their efficient resources on saving money. This move generated a system whereby HMOs power grew to the point that they dictate much of the way care is delivered. The result was a lessening of the importance of primary care as a patient's gatekeeper. Later, costs increased as efficiency decreased due to how care was being fragmented into unconnected pieces where the cheapest option was chosen.

Further exacerbating the problem, HMOs began to negotiate with providers for less than actual costs of care, causing physicians to be forced to write off the resulting losses. Eventually, those losses were great enough that health care managers had to begin limiting the number of patients accepted who were funded by certain HMOs to ensure their unit could stay fiscally solvent. TMA follows the same practice of negotiating prices with local providers. According to Surgeon General Green's briefing in May 2010 (Committee on Armed Services, 2010), expectations are that the changes related to FHI should show cost containment in the short term, with cost savings from preventive care benefits in the long term. The future effects this will have on the contractual RVU arrangement with TMA are unclear. Specific guidance on concurrent efficiency maintenance was not provided or is not currently available in official form.

The PCMH Concept

In its recent revival, there have been many versions of what PCMH principles or attributes. However, in 2010, the American Academy of Family Physicians (AAFP), American Academy of Pediatrics (AAP), American College of Physicians (ACP) and American Osteopathic Association (AOA), representing approximately 333,000 physicians, collaborated to present a summary of their joint statement on principles of the Patient-Centered Medical Home (The Patient-Centered Primary Care Collaboration, 2010):

- **Personal physician:** Each patient has an ongoing relationship with a personal physician trained to provide first contact and continuous and comprehensive care.
- **Physician-directed medical practice:** The personal physician leads a team of individuals at the practice level who collectively take responsibility for the ongoing care of patients.
- **Whole-person orientation:** The personal physician is responsible for providing for the entire patient's health care needs and taking responsibility for appropriately arranging care with other qualified professionals.
- **Coordination and/or integration of care:** Care is coordinated and/or integrated across all elements of the complex health care system (eg, subspecialty care, hospitals, home health agencies, nursing homes) and the patient's community (eg, family, public, and private community-based services). Care is facilitated by registries, information technology, health information exchange, and other means.
- **Quality and safety:** Quality and safety are hallmarks of a medical home, achieved by incorporating a care-planning process, evidence-based medicine, accountability, performance measurement, mutual participation, and decision making.
- **Enhanced access:** Enhanced access to care is available through systems such as open scheduling, expanded hours, and new options for communication between patients, their personal physician, and practice staff.
- **Payment:** Payment appropriately recognizes the added value provided to patients who have a patient-centered medical home beyond the traditional fee-for-service encounter.

Practices desiring formal PCMH recognition must go through a voluntary process to demonstrate that they have the capabilities to provide patient-centered services consistent

with the medical home model. The Air Force intends for its practices to apply for AAAHC Medical Home Status upon implementation of its FHI program. AAAHC evaluation standards assess somewhat different characteristics than that of the above organizations in that they do not broach the subject of costs or payment, but focus more on quality of care (AAAHC, 2010):

- **Relationship with the patient** and the patient's family and caretakers, and members of the Medical Home health care team
- **Continuity of care** including documentation of all consultations and appointments and proactively planned transitions of care
- **Comprehensiveness of care** including preventive and wellness care, acute care, chronic illness management and end-of-life care
- **Accessibility of care.** Patients are provided information about how to obtain medical care at any time, 24/7, 365 days a year
- **Quality, physician-directed care** and periodic assessment of evidence-based guidelines and performance measures
- **Electronic data management** is continually assessed as a tool for facilitating the above-mentioned standards

The PCMH model is a transformation which requires more than incremental practice changes. Early analysis shows that current demonstration participants introduce high risk when they often largely underestimate the magnitude and time frame required for accomplishing PCMH changes, as well as overestimate their readiness and expectations of information technology, and finally, seriously undercapitalize the entire process (Nutting et al., 2010). Evaluators express concern that those who implemented the model with these risks may set their practices up to fail (Nutting, et al., 2010).

The National Demonstration and Other PCMH Projects

In June 2006, a national study of 36 highly motivated health care practices began. The practices applied for the study and were selected based on their potential for successful implementation of the PCMH concepts; some had already implemented certain aspects or key tenets of the model. One feature of the study organizers felt was important was to include no monetary incentive to any participant in the study. The control group was given do-it-yourself instructions while the other group was given strong support with practice managers and nurses who visited the sites regularly, and offered encouragement and ideas when there were problems. The project used a combination quantitative and qualitative approach to tell the story of the 36 practices' experiences (Stange et al., 2010). The results were published in 2010. While there were some important observations made regarding implementation of the model, a more commensurate cost reimbursement system was not addressed other than to suggest that one is necessary and that efficiency decreases were seen in most practices.

Many of the subjects were unable to provide the financial information requested (Stange et al., 2010). It was noted that a very important factor that was not considered was a robust budget to cover upfront costs. Other factors included funding for better and more information technology and data collection, more integrated electronic records systems, employee turnover and the cost of training and efficiency losses. While provision for proper financial resources and data tracking seems intuitively necessary for any major new program implementation, financial support and incentive systems were not part of the NDP study. Additionally, relatively little guidance exists to suggest a way forward. Further, the NDP report indicated that each of the highly motivated and “well-

supported NDP practices was financially challenged by the project” (Nutting et al., 2008). Much of the reason for this lack of financial attention stems from the fact that the aims of the PCMH model take into consideration those aspects of primary care which are difficult to fragment and measure, with the intention being to lessen the potential for unintended devaluation of the relationship aspects of primary care (Stange et al., 2010). There is a broad agreement that these important aspects were fractured so badly in the 1990s that part of PCMH involved repairing that damage.

While none of the sources reviewed in this study contended costs are unimportant, moving so rapidly and completely into a reengineered delivery model cannot be done responsibly by sidelining the issue of resources. Such a prospect would be irresponsible, as the Air Force would be bound to repeat some of the same mistakes made with past care model changes. Moreover, cost increases are no longer an option, and require consideration of the affects of these changes from all aspects of the new model’s reach. It is exactly for this reason some pilot practices report being hesitant to move forward with totally implementing PCMH principles. Furthermore, military managers have an equally important responsibility to apply the most efficient mix of resources while serving.

In 2010, the Patient-Centered Primary Care Collaborative released more detailed guidance on the reengineering of suggested PCMH payment structures, which includes a staffing cost component (Patient-Centered Primary Care Collaborative, 2010):

Payment appropriately recognizes the added value provided to patients who have a patient-centered medical home. The payment structure should be based on the following framework:

- It should reflect the value of physician and non-physician staff patient-centered care management work that falls outside of the face-to-face visit.
- It should pay for services associated with coordination of care both within a given practice and between consultants, ancillary providers, and community resources.
- It should support adoption and use of health information technology for quality improvement;
- It should support provision of enhanced communication access such as secure e-mail and telephone consultation;
- It should recognize the value of physician work associated with remote monitoring of clinical data using technology.
- It should allow for separate fee-for-service payments for face-to-face visits. (Payments for care management services that fall outside of the face-to-face visit, as described above, should not result in a reduction in the payments for face-to-face visits).
- It should recognize case mix differences in the patient population being treated within the practice.
- It should allow physicians to share in savings from reduced hospitalizations associated with physician-guided care management in the office setting.
- It should allow for additional payments for achieving measurable and continuous quality improvements (PCPCC, 2010).

The NDP results have determined relatively few clear fiscal recommendations and there is a noticeable gap in the PCMH literature where any solid work output data are concerned. PCMH proponents frame the reason for this as being related to how such programs take years to implement. Yet practices cannot simply continue to assume efficiency will be affected by the same relationships in a like manner, while the entire method of health care delivery is reengineered.

The Air Force's Family Health Initiative

In August 2008, Ellsworth AFB, South Dakota and Edwards AFB, California began implementing the Family Health Initiative (FHI). In 2009, another ten family health clinics initiated the FHI program: Scott AFB, Illinois; Andrews AFB, Maryland;

Misawa Air Base, Japan; Patrick AFB, Florida; F.E. Warren AFB, Wyoming.; Bolling AFB, Washington, D.C.; Hill AFB, Utah; and Sheppard AFB, Texas. By the end of 2009, Laughlin AFB, Texas; Elmendorf AFB, Alaska; and RAF Lakenheath, England also began implementing the program. Twenty additional Air Force medical sites are slated to implement FHI by the end of 2010, including WPAFB Hospital. The Air Force expects to add other clinical specialties to their FHI model, including Pediatrics and Mental Health.

Staff Reengineering

The Primary care clinic will now be termed the Family Health Clinic. Physician teams will consist of one physician, one extender (a PA or NP), one nurse and five medical technicians. This differs from past configurations where a team consisted of perhaps 10 providers. Each team is “empanelled” or assigned 2500 patients. Providers who must also take a roll as Flight Commander or Element Chief will be assigned a lesser empanelment. PA’s and NP’s, termed “extenders” are the other half of the provider team, and are also empanelled. Disease Management Nurses are to be added, with WPAFBMC being authorized six based on the prevalence of chronic disease(s) in the local population. Patients are not to be seen by physicians or teams they are not assigned to. All active duty members must have unfettered access and be seen every time they request an appointment; however, other beneficiary categories have less priority.

Title X of the United States Code defines and delineates these priorities for the military: active duty dependents have the next priority, with retirees under age 65 and their dependents next. Finally, retirees over the age of 65 and their dependents constitute

the last level of precedence for access to care in the MTF (U.S. House, 2010). In the event the PCM or extender for those not on active duty is unavailable, under FHI mandates, they will be sent to see an outside provider. This is due to the PCMH emphasis on continuity of care within their facility. The emphasis is on each patient being able to be seen in their family clinic with their assigned provider or that provider's extender each and every time. While having the option for patients to be seen outside the facility is necessary to ensure access to care at all times, without a reworking of the available appointments, this concept could cause Air Force production to fall and costs paid to outside providers to rise.

An important question on the minds of managers involves the intent of keeping patients in-house for continuity's sake. Mandating that patients be sent out of that system if no appointments are available for just one of two provider options does not meet the needs of the customer. Patient medical records are not shared between civilian and military clinics, which lessen the chances for continuity of that patient's overall care. Patients then must learn and be reacquainted with a new provider, who perhaps they have never seen, and in a care system that is foreign to them.

Availability Reengineering

The FHI also mandates more access to the Primary Care Manager assigned to the patient. To do this, the provider's appointments schedule must increase to 36 daily for each provider team and 180 appointments per week. As well, the schedules are now opened for 90 days ahead of time. Yet managers are unsure what effects these changes will have on work production, due to the fact that their patient population is the driving force behind their demand, rather than the demand automatically being there with the

production capacity as the main limiting factor. Further, it is unclear what such an altered and standardized appointment template will do to efficiency when local deviations materialize.

The AFMOA has consistently provided informal updates to the FHI implementation process through the Air Force Knowledge Exchange. Through these communications, a projected Air Force staffing model for FY 2010 was established and shared service-wide. The intricacies of a program with such a scope have meant that staffing concerns are site-specific and ongoing. While there are some essentials of the program that relate back to similar programs in the 1990s and early 2000s, many elements are dissimilar. The PCMH concept supports the idea that the relationship between a member and their provider will improve by ensuring they are seen by the same health care team each and every time they make an appointment. The program's formal Air Force Instruction (AFI) or CONOPS has not been released, although the document has been planned for release since 2008.

Managerial Inclusion

In the case of the FHI, a military health care team was brought together to implement the program and manage care. The team is comprised of esteemed subject-matter experts, yet while one of the seven tenets of the PCMH model includes the cost realm, members of the managerial team do not include an authority in fiscal matters. The current members include The Air Force Surgeon General, a family practice consultant, five family physicians, an ambulatory nursing consultant, two nurses, two medical technicians and a General Practice Management (GPM) consultant, covering the major

strategic and operational considerations for programs (Kosmatka, 2010). While the GPM functions as an organizational program manager in the health care setting and can provide insight on efficiency of per-capita staff output, they generally do not provide analyses on patient demand or costs. Further, metrics and statistical investigation are not currently being requested or performed regarding production efficiency during the FHI implementation. This has implications for the Air Force that could mean the FHI affects will not be identified in time to avoid some of the same potentially fatal blows to past care improvement initiatives.

With the difficult task of reengineering health care delivery upon them, it is time for the Air Force to ask some resource-intensive questions such as: what work outputs will the model's implementation affect and will RVU's decrease with the efforts of the DMs? Is demand enough that this can be offset by increasing patient empanelment? If demand decreases without a decrease in staffing, what data do we have to give us direction? While managers are confident they have some effective control tools at their disposal, the FHI has cast some new uncertainty on future health care supply and demand.

Summary

The main goals of implementing the PCMH model in any health care environment relate to improving the delivery and quality of care. While relatively little data have been collected, produced or reported on the work output and efficiency-related costs of the PCMH model, even less information is available regarding the same efforts in public

institutions such as the Air Force's health care system. A solid assessment of the existing work production landscape will be necessary to understand the potential fiscal risks the PCMH model could impose. Moving forward with their innovative reengineering of primary care, Air Force health care leadership will be challenged to scrutinize the evolving PCMH literature for potential applications of the output-focused PCMH concepts that can be beneficial to apply within their scope of care.

Health care managers will require additional resources to study, collect and report such data, as well as the authority to then make meaningful, data-driven changes to their systems. If managers are unable to predict production output well, it will ultimately affect their resources, and thus their ability to improve their practices. With today's budgetary realities, programmatic failures cost time and resources of such a magnitude that they are indefensible.

Chapter III. Methodology

This chapter presents an outline of the multiple regression analysis used to develop a predictive model for Enhanced Work RVU output at WPAFBMC. This chapter will begin with an account of the data collection process, the variables considered, and the population selection criteria. This is followed by a section on the multiple linear regression process, including steps in statistical and graphical analysis that were used to aid in evaluating whether a statistically significant relationship exists between any or some of those variables and the RVU production output. These steps include assessing each variable separately, in relation to the others and in relation to the dependent variable. Finally, presenting a calculation of the regression equation and examining the measures of association and tests of statistical significance will be detailed.

Multiple Linear Regression Model Development

This research effort aimed to establish whether a statistically significant relationship exists between patient workload demand and the per-encounter variables collected at the WPAFBMC Primary Care Clinic. As established in Chapter II, the most recent and relevant effort in this area utilized univariate analysis of variance, rather than multiple linear regression (Moniz, 2008). The data in the prior study were pulled from M2 with each of 1,529 data points representing a workload for a group of patients with a

certain set of characteristics. In contrast, this study considered all encounters on a per-encounter basis from primary care during the period studied.

Multiple linear regression analysis is “a means to express the idea that a response variable, y , varies with a set of independent variables, x_1, x_2, \dots, x_m ” (SAS©, 2010). The SAS description continues by stating that the variability that y exhibits has a systematic part and a stochastic (or random) part, whereby the systematic variation of y is modeled as a function of the x variable(s) (SAS©, 2010). The systematic variation in a relationship can be represented by a mathematical expression, whereas stochastic variation cannot. Further, stochastic variation addresses the reality that a model is not able to perfectly describe the behavior of the response (SAS©, 2010). Performing linear regression analysis will demonstrate whether the independent qualitative and quantitative variables pulled from M2 show correlation with the dependent variable of work production output in RVUs. A general multiple regression analysis follows the subsequent steps:

1. State the research hypothesis
2. State the null hypothesis
3. Gather the data
 - *Assess each variable separately*
 - *Assess the relationship of each independent variable with the dependent variable*
 - *Assess the relationships between all independent variables with each other*
4. Calculate the regression equation
5. Examine measures of association and tests of statistical significance
6. Relate statistical findings to the hypothesis and accept or reject the null hypothesis
7. Reject or accept the research hypothesis; make suggestions for research design and management aspects of the problem; explain the practical implications of the findings

(Saint-Germain, 2010)

Step 1: State the research hypothesis:

The research hypothesis in this study is: the work production output at WPAFBMC primary care (in RVUs) is statistically affected by the per-encounter independent variables of age, gender, beneficiary category, provider specialty, evaluation and management code and appointment type.

Step 2: State the Null Hypothesis:

The null hypothesis is that the work production output is not explained by the variables age, gender, beneficiary category, provider specialty, evaluation and management code and appointment type.

Step 3: Gather the Data:

Data collected for this multiple linear regression effort were pulled from the Military Health System Management Analysis and Reporting Tool (M2) for fiscal years 2009 and 2010. All patient encounters in Primary Care were pulled for all days of the fiscal year. The data included the variables of age, gender, beneficiary category, date, procedure code, number of encounters, record identifier, provider specialty, evaluation and management code and appointment type. Those variables considered and analyzed in this multiple regression model included: age, gender, beneficiary category, provider specialty, evaluation and management code and appointment type. A more detailed explanation of the process used for inclusion is presented below.

The population considered in this thesis consisted of all enrollees who were physically seen or tended to over the telephone at Wright Patterson Air Force Base Medical Center (WPAFBMC) within FY 2009 and FY 2010 in the primary care clinic. No criteria other than this were placed on the population considered. The dependent and independent variables are described in detail Chapter IV.

Assess Each Variable Separately

The independent variables selected for consideration in this model were assessed separately as either categorical or numerical entities and were ultimately placed into either the “continuous” or “nominal” category in JMP®. Categorical variables include responses that belong to groups or categories, while numerical variables include those that are both discrete and continuous (Newbold, Carlson, Thorne; 2010, p. 27). Continuous numeric variables can “take on any value within a given range of real numbers, and usually arises from a measurement (not a counting) process” (Newbold et al., 2010, p. 27). Discrete numerical (nominal) variables can be numeric or character and refer to data that has a finite number of values (Newbold et al., 2010, p. 27). In JMP®, variables are simply categorized as “Continuous”, “Ordinal” or “Nominal”.

In multiple regression analysis, categorical variables can require a structure whereby they take on only two possible values: $X_j = 0$ and $X_j = 1$. Termed “indicator” or “dummy” variables, these structures can aid in situations where a variable does not exist over a range and contain many different values (Newbold, Carlson, Thorne; 2010, p. 27). In an example of a regression equation:

$$Y = \beta_0 + \beta_1 X_1$$

where y is the response variable, β_0 is the constant, x is the independent variable, and β_1 is the unknown parameter being estimated in the analysis (SAS, 2010). Introducing a dummy variable that has values of 0 and 1 results in an equation of the form:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2$$

Where when $X_2 = 0$, the constant is β_0 and when $X_2 = 1$, the constant is $\beta_0 + \beta_2$; shifting the “linear relationship between y and x_1 by the value of the coefficient β_2 ” (Newbold et al., 2010, p. 556). This is constructive where use of dummy variables allows for the representation of a shift in the regression equation; an example of this would be when a linear function shifts in response to a specific influence, only part of which is included in a variable’s values (Newbold et al., 2010, p. 556). In multiple regression analysis, interaction variables can be created for continuous variables.

This analysis included only one continuous variable, and therefore did not include interaction variables. Independent continuous and nominal variables were utilized in this thesis effort. Those variables that have been historically credited as having predictive effects on primary care work production output were included. In order to afford the opportunity to predict a more vigorous model than what has been produced previously, additional nominal per-encounter variables were considered. Moreover, in the interest of producing a parsimonious model, only those variables which showed the greatest predictive ability will be included.

Linear regression analysis requires the following four assumptions about the random error term which are used to “make inferences about the population linear model by using the estimated model coefficients” (Newbold et al., 2010, p. 450):

1. The y values are linear functions of x plus a random error term (ε_i).
2. The x values are fixed numbers, or they are realizations of random variable x that are independent of the error terms, ε_i ($i = 1, \dots, n$). In the latter case, inference is carried out conditionally on the observed values of x_i ($i = 1, \dots, n$).
3. The error terms are random variables with a mean of 0 and the same variance σ^2 . The latter is called homoscedasticity or constant variance:

$$E[\varepsilon_i] = 0 \text{ and } E[\varepsilon_i^2] = \sigma^2 \text{ for } (i = 1, \dots, n)$$

4. The random error terms, ε_i are not correlated with one another, so that:

$$E[\varepsilon_i \varepsilon_j] = 0 \text{ for all } i \neq j$$

An assumption is made in a linear regression that “for every X there is a mean value of Y , plus a random error term” (Newbold et al., 2010, p. 449). Random error signifies all influences on the dependent variable (Y) which are not represented by the linear relationship between Y and X , and behave as a random variable whose population mean is zero (Newbold et al., 2010, p. 449). To obtain measures of central tendency for each variable, population means should be calculated and used for analysis in conjunction with the shape of that variable’s distribution. Frequency distributions, along with box plots to highlight means and outliers, will aid in determining if the variables are normally distributed.

Assess the Relationship of Each Independent Variable with the Dependent Variable

Relationships between two variables are expressed mathematically as an equation, whereby a response variable Y is fitted to a function of “regressor variables and parameters” (SAS©, 2010). A universal linear regression model takes the form:

$$Y = \beta_0 + \beta_1 X_1 + \dots + \beta_i X_i + \varepsilon$$

where Y is the dependent variable (work production output in RVUs), $\beta_0, \beta_1, \dots, \beta_i$ are the regression coefficients determined by the analysis X_1, X_2, \dots, X_i are the independent, variables (per encounter data), and ε is a stochastic error term which accounts for random error in the model (SAS©, 2010).

An assessment of the relationship of each independent variable, one at a time, with the dependent variable is performed using Fit Y by X in JMP©. The Fit Y by X determines the difference between the regression sums of squares using a “least squares” method to estimate the parameters. The objective is to “find estimates of the parameters $\beta_0, \beta_1, \dots, \beta_i$ that minimize the sum of the squared differences between the actual y values and the values of y predicted by the equation” (SAS, 2010). Such estimates are termed the “least-squares estimates”, while the quantity minimized is called the “error sum of squares” (SAS, 2010).

Assess the Relationships between all Independent Variables with Each Other

Assessment of the relationships between all independent variables with each other is performed using a Multivariate analysis in JMP©. As stated above, multivariate analysis was not beneficial in this case; due to the fact only one of the variables was a continuous variable. Therefore, Fit Model in JMP© fits uses general linear models to perform simple and multiple regression, as well as analysis of variance and stepwise regression (SAS, 2010). Simultaneous inclusion of all potential variables is a method of understanding which variables will potentially create a most predictive model.

Therefore, a Tukey-Kramer (TK) analysis on a one-way Fit Y by X examines independent variables containing multiple groups to compare each pair of groups, thereby producing a p -value for each group (SAS, 2010). The p -value constraint in this study

was set at 0.05 in order to show an overall experiment-wide error rate of less than 5 percent. Upon calculation of a p -value for each variable's coefficient, a value less than 0.05 indicates whether the independent variables were each statistically significant (or different than zero). If the p -value is less than 0.05, this also indicates that the null hypothesis can be rejected. After gaining an understanding of these relationships through the TK analysis, dummy variables can be produced which should have the best chance at being the most predictive possibilities in the model. A stepwise regression can then aid in the analysis of all possible regressions, thus validating whether the TK predictions do indeed show statistically significant relationships that add predictive ability to the model (SAS, 2010).

To address the independent variables' level of correlation, or multicollinearity, the model must show a coefficient of determination, or R^2 , that is high while the corresponding p -value is low. The R^2 value increases directly with the spread of the independent variable, and can be defined as the percent of variability in the dependent variable (Y) which is explained by the model" (Newbold et al., 2010, p. 463). By separating the total sum of squares variability (SST) in the model into that which can be explained (SSR), and that which cannot (SSE) the R^2 can be calculated as:

$$R^2 = SSR/SST = 1/(SSE/SST)$$

where SSR represents the variability explained by the slope of the equation, while SSE represents the variability explained by the random deviation of points from the regression

line. The result is a ratio that ranges from 0 to 1, where higher values equate to a “better regression” (Newbold et al., 2010, p. 463).

A further test to determine whether multicollinearity exists is the variance inflation factor (VIF). The VIF score, calculated by JMP®, is calculated by subtracting the R^2 from 1 and dividing one by that “tolerance” amount: $VIF = 1 / (1 - R^2)$. A desirable VIF score is less than 5, with less than 2 being most advantageous. A higher R^2 will produce a lower VIF score. Because the R^2 value can be high merely by virtue of there being many variables entered into the model, and not because each is an important predictor variable, the adjusted R^2 value compensates for this. The adjusted R^2 should be used as a more accurate measure than R^2 , as it “corrects for the fact that non-relevant independent variables will result in some small reduction in the error sum of squares” (Newbold et al., 2010, p. 524).

Step 4: Calculate the Regression Equation from the Data

Once the least squares technique finds estimates of the parameters $\beta_0, \beta_1, \dots, \beta_n$ that best minimize the sum of the squared differences between the actual y values and the values of y predicted by the equation, and the above processes have been performed, the regression equation can be deduced from the data. In JMP®, the regression equation is calculated using the slope formula, while the slope and coefficients are found by using the Fit Y by X tool (SAS, 2010) as shown in Figure 3-1. The Fit Y by X tool will produce an output which includes a fit- plot of the data, R^2 and adjusted R^2 , analysis of variance, and the regression slope and coefficients as shown in Figure 3-2. To ensure

there are no data points which exert undue influence on the model, a Cook's Distance test was performed. If the Cook's Distance indicates the existence of data points that are particularly influential, each will be considered individually for validity, and are denoted by points that lay beyond 0.25 in this study. The final step in the regression model is to specify the linear model's p independent variables and coefficients, in the form of:

$$Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \dots + \beta_p X_{ip}$$

where Y_i is the dependent variable, β_i are the regression coefficients for that variable, and X_i are the independent variables.

Standard Slope Formula

$$\frac{\sum (x - \bar{x})(y - \bar{y})}{\sum (x - \bar{x})^2}$$

$$\begin{aligned} XY &= \sum_{i=1}^{NRow()} [(X_i - \text{Col Mean}(X)) * (Y_i - \text{Col Mean}(Y))]; \\ Xsqrd &= \sum_{i=1}^{NRow()} (X_i - \text{Col Mean}(X))^2; \\ \frac{XY}{Xsqrd} \end{aligned}$$

Figure 4. Standard Slope Formula (SAS, 2010)

The Fit Y by X tool will produce an output which includes a fit-plot of the data, R^2 and adjusted R^2 , analysis of variance and finally the regression slope and coefficients:

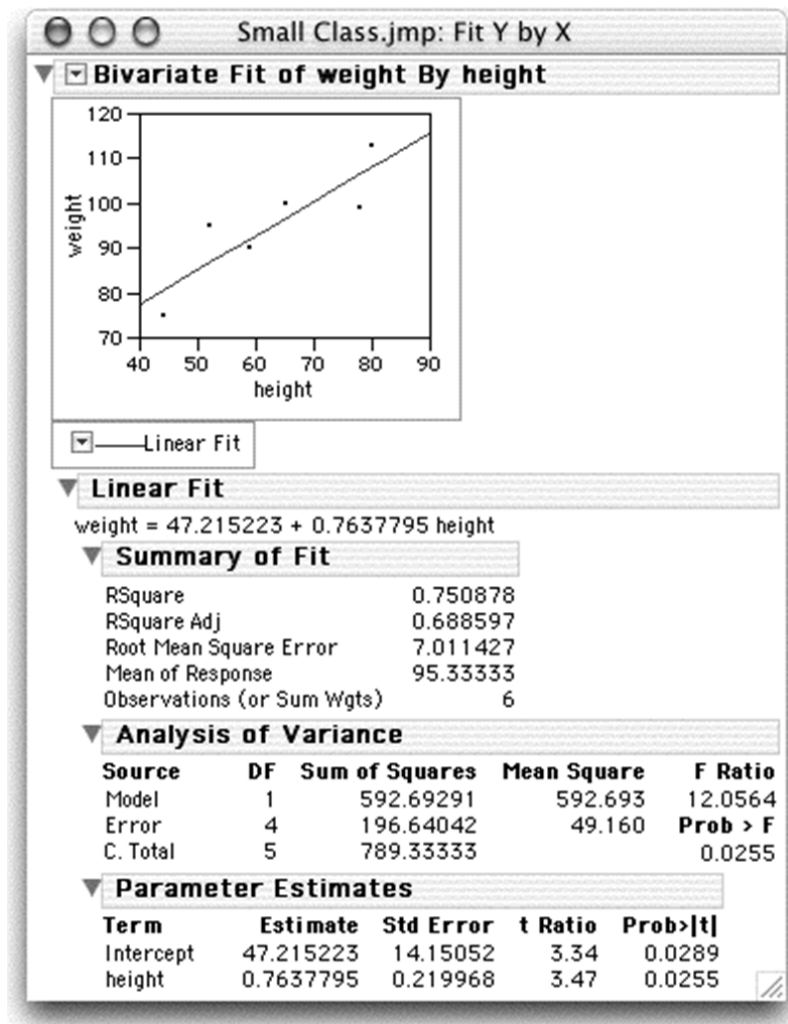


Figure 5. JMP© Fit Y by X (JMP©, 2010).

Step 5: Examine Measures of Association and Tests of Statistical Significance

Calculation and examination of appropriate measures of association involve iterative testing to ensure the R^2 and adjusted R^2 are acceptable in relation to the problem being considered, as well as their relationship to each other, as detailed above. Further, tests for normality, constant variance and independence must be performed in order to confirm the assumptions made about the model's random error term. Normality is

diagnosed through the Kolmogorov-Smirnov-Lilliefors (KSL) test. The residuals of the model, or the difference between the observed and predicted values of Y , will be normally distributed if the null hypothesis can be supported. If the KSL is run on the residuals and the p -value is less than 0.05, the null hypothesis may be rejected. Constant variance is verified through analysis of the SSR and SSE in a Breusch-Pagan test. In the Breusch-Pagan test, the squared residuals are analyzed as the dependent Y factor, with the identical independent X variables chosen for the final regression model. In this way, the SSR can be deduced in an Analysis of Variance (AOV) through the Breusch-Pagan equation:

$$(SSR/2) / (SSE/n)^2 = \text{test statistic}$$

where the test statistic is treated as a p -value with a desired value of less than 0.05.

Independence is proven through the maintenance of acceptable adjusted R^2 values and VIF scores, as detailed above.

Step 6: Relate statistical findings to the hypothesis and accept or reject the null hypothesis

The model must pass all measures of association, test of significance, and tests of validity, for conclusions to be drawn about the null hypothesis. The regression analysis results are thus related to the null hypothesis and a determination was made about whether the null hypothesis would be rejected.

Step 7: Reject or accept the research hypothesis; make suggestions for research design and management aspects of the problem; explain the practical implications of the findings

Once the acceptance or rejection of the null hypothesis has been established, the results are presented and the implications of the findings are discussed. This will be done in order to inform the reader on whether the information gained through this analysis is consistent with current norms and procedures in analysis and forecasting of work production output. Further discussion will then focus on future research endeavors.

Summary

This chapter presented the methodology used in this thesis study to produce a multiple linear regression equation. Upon presentation of a multiple linear regression model, the research and null hypotheses were detailed with a discussion of the data set and population. The chapter presented how each variable was assessed separately and then through the significance of its relationship with the other independent variables and the dependent variable. Next, the regression equation was presented and subsequently subjected to tests of normality, constant variance, and independence. Calculations were made of the appropriate measures of association and statistical significance, and an analysis of distributions, correlations, and multicollinearity were performed. This chapter presented the construct necessary for the analysis results presented in Chapter IV.

Chapter IV. Results and Analysis

This chapter provides a synopsis of the multiple regression analysis results to answer this effort's research questions. The multiple linear regression process included statistical and graphical analysis to evaluate whether a relationship exists between any or some of the independent variables and the RVU production output. The statistical findings are related to the hypotheses and a decision to accept or reject the null hypothesis is made. Finally, this chapter presents a validation of the model's predictive ability and provides related discussion.

Variables

As articulated in Chapters I and II, several variables were proven to be predictive of RVU work output in this thesis effort. Some of the variables supplied through the M2 database system were deemed either irrelevant to this study or unreliable due to the unacceptably sparse data that were kept in that specific category. As potential dependent variables, simple RVU count and Enhanced RVU counts were collected and considered. Simple RVU count, as detailed above, was an historical measure that has since been replaced by Enhanced RVU counts, and will not be used by any MTF in the future. While the data provided by M2 in FY 2009 and FY 2010 were administered at the time by the MTF staff using simple RVUs, for this study's purposes, RVU counts per encounter were reassigned in M2 with Enhanced RVU amounts. This was done to consider data that is the most relevant for future studies. All data in this effort were considered in relation to Enhanced RVU counts only.

Personally identifiable provider information was available through M2 but was not included or utilized in this study. Additionally, several other variables were set aside: date, week and month, record identifier, number of encounters and procedure code. Discussion of the rationale for these choices is included under each variable below. The variables were categorized as either continuous, numeric or nominal, qualitative. Enhanced RVU count, simple RVU count, and age were treated as a continuous, while the remaining measurement of values, while the remaining variables of gender, beneficiary category, date, week, month, procedure code, number of encounters, record identifier, provider specialty, evaluation and management code and appointment type were treated as nominal data. While some of the nominal variables were reported numerically, there was no implicit order related to the numbers in their categories. These included beneficiary category, date, week, month, procedure code and number of encounters.

Of the variables included for consideration in this effort, there were 2,277 encounters in FY 2009 and 34 encounters in FY 2010 that did not include an E&M code. Furthermore, 19 encounters in FY 2009 and 6 encounters in FY 2010 included no Enhanced RVU data and were assumed to be zero since the corresponding Simple RVU data were zero as well. All remaining categories of data were complete. Ultimately, the variables considered in this multiple regression model included age, gender, beneficiary category, month, provider specialty, evaluation and management code, and appointment type.

Variables Considered and Set-Aside

Simple RVUs

The simple RVU is a common accounting standard stipulated and managed by CMS, and used in the DoD healthcare community. RVUs are composed generally of the cost value assigned to physician's work, their practice expenses (or overhead) and liability insurance. The value of RVUs per encounter is based on the amount of time a provider spends with their patient. Simple RVUs were used through FY2010 but have since been replaced with Enhanced RVUs, which include a provision for practice expenses. Simple RVUs were ruled out as a Y factor, as they are no longer relevant.

Provider

Specific provider identification was available, but not included in this study. Because staffing particular to the specific member is not within the control of the managers to affect in the short term, provider was ruled out as an independent variable.

Patient

Specific patient identification was available but not included in this study. This was due to the fact that this study was not concerned with the RVU output differences per specific patient. One additional argument for this decision is that the ability to affect the inputs to RVU production which are related to the specific patient are limited; furthermore, aiming to increase the RVU count based on aiming to attract specific patients would be an ethically unsavory health care practice. Theoretically, it should be only through the new FHI program that a health care staff member (nurse disease manager) might have the capacity to affect the per-patient RVU output. Such an effort, it

can be argued, would be one to *reduce* the number of visits needed and the severity of the related care, thus potentially *reducing* the RVU output.

Week

The week of the year, delineated as Monday through Sunday, is numbered 1-53. Ultimately, the week of the year did not prove to be a useful metric for the WPAFBMC users since RVU output is measured as a monthly output. Moreover, the ability to affect the inputs to RVU production which are related to the week of the year is limited; provider and extender appointment quantities and types are normally set weeks ahead of time. The week was not considered as a variable in the final model.

Date

The specific date was included on each patient encounter in this data set. Ultimately, however, the date did not prove to be a valuable metric for the WPAFBMC users for the same reason stipulated above for the week variable: RVU output is measured as a monthly output and the ability to affect the daily inputs to RVU production is limited. The date was not considered as a variable in this study's final model.

Encounters

Encounters in this study denote one appointment or telephone consult with a patient. Since the number of encounters has no impact on predictive capacity, it was not included in the regression analysis.

Encounters

Encounters in this study denote one appointment or telephone consult with a patient. The number of encounters per encounter in this data set did not differ from 1 on

any patient encounter. Therefore, a decision was made that there is no ability for this variable to add any predictive capacity to a regression equation.

Procedure Code

Procedure codes, also termed “ICD-9 Provider & Diagnostic” codes, or International Classification of Diseases, are 3 to 5-digit numeric and alphanumeric codes that describe services rendered for specific medical conditions and disease states (CMS, 2010). Each encounter in this data set was given up to 4 procedure code columns, denoting how the patient could have had up to 4 procedures in one visit. Of the original 162,610 encounters in this study, procedure 1 included 2,054 codes, procedure 2 produced 539 codes, procedure 3 produced 30 codes and procedure 4 produced 7 codes. Examples and descriptions of the most prolific procedure codes contained in the data set for this study:

98966 (965 encounters) - Telephone assessment and management service provided by a qualified non-physician health care professional to an established patient, parent, or guardian not originating from a related assessment and management service provided within the previous seven days nor leading to an assessment and management service or procedure within the next 24 hours or soonest available appointment; 5-10 minutes of medical discussion

17110 (676 encounters) - Destruction of flat warts, molluscum contagiosum, or milia; up to 14 lesions.

Q0091 (352 encounters) - Screening Papanicolaou (Pap) smear, obtaining, preparing and conveyance of cervical or vaginal smear to laboratory

96372 (556 encounters) - Therapeutic, prophylactic or diagnostic injection (specify substance or drug); subcutaneous or intramuscular

93000 (265 encounters) - Complete Electrocardiogram, routine performed or ordered as part of a visit or consultation

90804 (207 encounters) - Insight oriented, behavior modifying and/or supportive psychotherapy

(CMS, 2010)

Procedure codes existed within the data set for only a small fraction (1.26%) of total encounters, while others did not have a code in any procedure column. Some encounters had more than one procedure code, or were missing a procedure code in the first column but had a code in a later column. While it is likely that these codes may affect the total RVU output, this variable was set aside as potentially having an overly influential affect on the regression.

Variables Considered for Model Inclusion

The following variables were considered for inclusion in the final regression model of this study.

Month

The months in the period studied covered all days of each calendar month in which any Enhanced RVUs were generated. While governmental work production calculations generally assume a certain number of work days per year, it was noted in this data set that often there were Enhanced RVUs produced on the weekend dates. Thus, all days during each month were included.

Age

Patient age in years is documented per primary care encounter. The age variable was used in totality as a continuous variable and was later classified as a categorical variable with the following delineations.

1. 0-4
2. 5-17
3. 18-24
4. 25-34
5. 35-44
6. 45-64
7. 65-98

Specifically, these age cohorts were chosen in order to determine if patient demographics during this period at WPAFBMC would mimic the results found by Moniz (2008).

Moreover, military membership does not normally commence before age 18, which is where the majority of primary care encounters begin. For the period studied, only 13 encounters of 162,610 were for patients less than age 18. It was thus determined that 17 should be the cutoff for the first adult age cohort.

Gender

Patient gender is documented per primary care encounter and has been shown to be a predictor of the magnitude of health care consumption (Moniz, 2008).

Beneficiary Category

The beneficiary category (BenCat) denotes whether a patient falls into one of four categories, each of which gives the patient a particular priority in access to care at a MTF. Active duty members have the highest priority, as stated in Chapter II, per Title X authority. Active duty members' dependents have the next priority, while retirees and their dependents have the last priority. BenCats are numbered 1 through 4; however, the number system is not indicative of the priority given as shown below. For context and comparison, beneficiary categories per encounter are shown in Table 4-1.

1 – Active Duty Dependent

2 – Retiree Dependent

3 – Retiree

4 – Active Duty

For context and comparison, beneficiary categories per encounter are as follows (Table 4):

Table 4. Beneficiary Category Statistics per Encounter at WPAFBMC (FY 2009-FY 2010)

BenCat	Priority	Total Encounters	% of Total Encounters	Total Enhanced RVUs Generated	% of Total RVUs Generated
1	Active Duty Dependant	19,626	12.07%	31,318	12.94%
2	Retiree Dependant	46,783	28.77%	69,275	28.61%
3	Retiree	53,961	33.18%	79,511	32.84%
4	Active Duty	42,240	25.98%	62,004	25.61%

Provider Specialty

Provider specialty is a category with 15 possibilities. Each category represents a type of staff member who is capable of producing RVUs in an encounter with a patient,

and who actually did so within the period studied. The provider specialty codes are shown in Table 5.

Table 5. Provider Specialty Codes

Provider Specialty Code	Type of Provider
0	General Medical Officer
1	Family Practice Physician
202	Medical Chemist (Pharmacist)
300	Aerospace Medicine Physician
302	Aerospace Medicine Flight Surgeon/Family Practice Physician
321	Occupational Medicine Physician
600	Nurse, General Duty
604	Primary Care Nurse Practitioner
613	RN Case manager
702	Clinical Psychologist
703	Psychology Social Worker
714	Social Worker, Case Manager
750	Pharmacist, General Practice
900	Corpsman/Technician
901	Physician's Assistant

Evaluation & Management (E&M) Code

E&M codes, as described in Chapter II, are 5-digit codes assigned electronically as the patient is seen. The codes are broken into patient categories which delineate whether that patient is new or established, the specifics of their health history, the required exam itself and the related medical decision-making involved (AMA, 2010). Examples of WPAFBMC's most utilized codes (85.69% of the total encounters) and their definitions are (Table 6):

Table 6. WPAFBMC Primary Care Most utilized E&M Codes (Adapted from AMA; CMS, 2010).

E&M Code	Number of Encounters FY 2009 & FY 2010	Description
99213	31,051	Office Visit -Expanded problem focused history -Expanded problem focused examination -Medical decision making of low complexity -Typical face-to-face time 15 minutes
99214	50,383	Office Visit -Detailed history -Detailed examination -Medical decision making of moderate complexity -Typical face-to-face time 25 minutes
99441	15,283	Telephone Consult -History of present illness -Diagnosis -Test ordered -Medication management -Other management options 5-10 minute session
99499	37,593	Unlisted Service Rare circumstance when a physician (or NPP) provides a service that does not reflect a CPT code description

Appointment Type (Scheduled, Walk-in (sick call), Telephone Consult)

Each encounter in primary care is coded according to its appointment type with numeral 1, 3, or 6. Appointment type 1 is described as one that is scheduled before the day of the appointment and is typically used for a condition that is of a chronic or non-

urgent nature. Appointment type 3 denotes a patient who has requested an appointment for the same day, once termed “sick call.” Same day appointments are meant for a condition that is considered acute in nature. Appointment type 6 describes a telephone consult with a staff member in the primary care clinic.

Variable Analysis

Analysis of this study’s variables was performed using JMP®, which is a software that provides a range of graphical and descriptive statistical methods for analysis of variance in regression model development. As detailed in Chapter III, the null and research hypotheses were first established, and then data were gathered from M2. Next, a qualitative assessment of dependent variable options and each independent variable was made to determine its validity or value for inclusion in the model. With the potential variables assessed and chosen, the relationship of each was evaluated against the dependent variable and then amongst each other using descriptive and inferential statistics. Descriptive statistics “focus on graphical and numerical procedures that are used to summarize and process data,” while inferential statistics “focus on using the data to make predictions, forecasts, estimates to make better decisions” (Newbold, et al., 2010, p. 26).

Scatter Plots

Scatter plots were not particularly useful in this analysis, as age was the only continuous variable: age. Figure 5 shows the JMP® scatter plot for Enhanced RVUs and the patient age, per encounter. Two things are clear from this visual depiction, namely

that most primary care encounters begin happening near age 17 to 18, and the slightly downward sloping curve shows a decreasing average RVU output per encounter, as age increases. Because there were such a large number of data points included in this effort, the scatter plot does not indicate whether outliers exist; however, until the age of 17 to 18, each encounter is easily identified, due to the relatively low number of patient encounters in that age range.

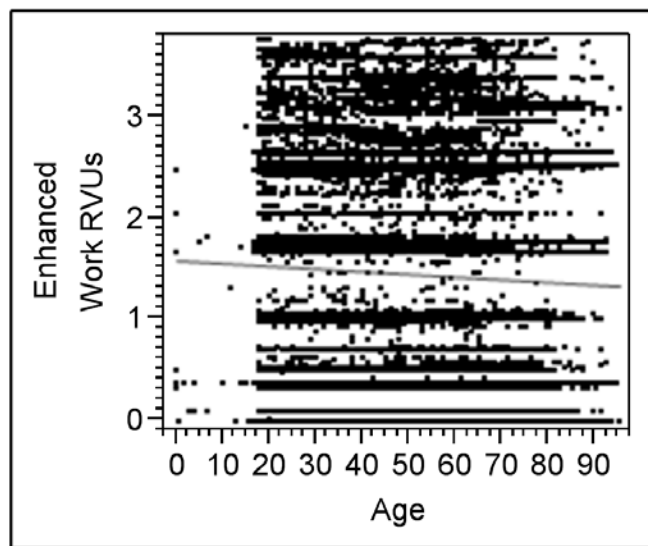


Figure 6. JMP© Scatter Plot: Enhanced RVU Output per Encounter vs. Patient Age

Histograms

Histograms were used to the greatest degree in this analysis. While their mathematical correctness may not be precise due to the fact they cannot be scaled on the vertical axis, histograms provide insight into the shape of the data (Newbold et al., 2010, p. 44). Histograms show the division of data points with the degree of kurtosis and skewness. Kurtosis is depicted visually by the degree of the data distribution that falls

around the mean, while skewness is shown by the amount of distortion, or lack of symmetry about the mean (Newbold et al., 2010, p. 646).

Box Plots

As a visual cue and tool, outlier box plots were of limited application in this analysis process. This was due to the high number of encounters in the data set, which made such visual conclusions difficult. The two instances of the box plot's use in this study are detailed below.

Data Analysis

The data set included 162,610 encounters over the FY 2009 and FY 2010 period. Data were initially analyzed monthly due to the WPAFBMC metric reporting cycles; however, it was difficult to attribute monthly variations only to one or specific variable(s). The annual RVU count was the more important consideration for the user due to contractual obligations to produce a certain amount annually, thus all encounters were included. Evaluation of the Enhanced RVU output in Figure 4-2 showed a distribution which clearly indicated a right-skew, while the box plot showed some potentially extreme data points.

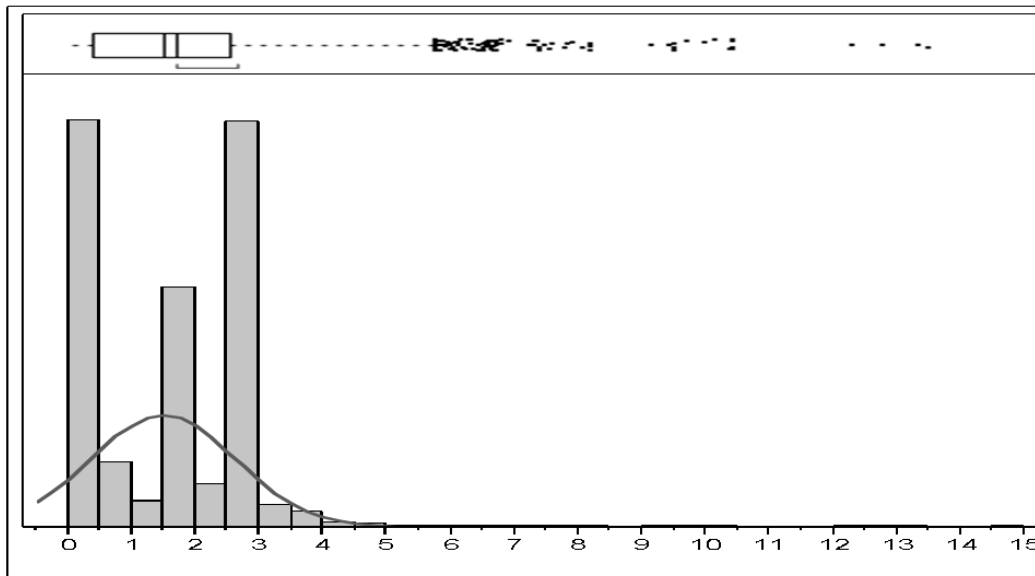


Figure 7. Distributions Enhanced RVUs.

Visually, there appears to be a fairly obvious drop off in the amount of encounters that produced RVUs in excess of 5.0. This, coupled with the mean at 1.49 does not tell a complete story, however, because there are wide variations in the distribution at points in between. An Excel Pivot Table was used extensively in this study to understand the relationships between variables. The pivot table is a tool for comparison, manipulating, and understanding the relationships between data and its categories, thus allowing each variable to be numerically considered in relation to the other variables on a per-encounter basis. In the case of the distribution of Enhanced RVU output, the cumulative histogram results showed that 99.1 percent of all RVUs were equal to or below 3.8. Thus, for the purposes of this study, RVUs that totaled higher than 3.8 per encounter were set aside. Additionally, the skewed right tail in the distribution showed that this would affect only

1,466 of the total encounters, thus decreasing the chances that a few data points could overly influence the model.

Regression Model

All independent variables were placed into a Fit Y by X model and regressed using a linear model of the form,

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7$$

where:

Y_i = Enhanced RVU work production output

$\beta_0 \dots \beta_i$ = coefficients

X_1 = Age

X_2 = Gender

X_3 = BenCat

X_4 = Month

X_5 = Provider Specialty

X_6 = E&M Code

X_7 = Appointment Type

Initial results were promising, with a R^2 of 0.98 and adjusted R^2 of 0.98, with a max R^2 of 0.99. The VIF scores were much above the threshold of 5.0, however. Age, gender and appointment types had p-values below the 0.05 limit while E&M codes, provider specialties, months and BenCat showed a mix of acceptable p-values, depending on the actual parameter. Elimination of the variable gender continued to show all remaining variables as potentially predictive.

With so many prospective variables, each required further iterative analysis both separately and with the dependent variable. Gender, age, BenCat, and months proved

non-predictive, each with R^2 and adjusted R^2 values less than 0.02. Breaking age into cohorts also produced non-predictive results, with R^2 and adjusted R^2 values less than 0.02. These variables were then set aside for later potential inclusion and further analysis. E&M codes proved highly predictive with an R^2 of 0.98 and adjusted R^2 of 0.98. Appointment Types proved highly predictive as well with a R^2 of 0.82 and adjusted R^2 of 0.82. Provider Specialty also proved predictive with a R^2 of 0.45 and adjusted R^2 of 0.45. With E&M codes, Appointment types and provider specialties in the model, a R^2 of 0.98 and adjusted R^2 of 0.98 were achieved. The VIF scores were no less than 9.8 and rose up to 27,174.9 on some parameters, however; showing an unacceptable amount of multicollinearity.

An iterative TK analysis was performed to understand the specific groups within these variables which would provide the best predictive and parsimonious possibilities for the model. All appointment types were found to be acceptable, with low VIF scores at 2.59; and as a single variable were highly predictive. As a categorical variable, each appointment type was categorized as a dummy variable. To further confirm that the variables chosen should be the most predictive possibility, a Stepwise analysis of all possible regression equations including Provider Specialty, E&M codes and appointment types was performed in JMP®. All appointment types and various combinations of E&M codes and provider specialties were confirmed as highly predictive with a high probability of significance. Stepwise showed the top 12 possible variables as having 0.00 p-values and no less than an adjusted R^2 of 0.98.

Dummy Variables

Appointment type dummy variables were created for the 3 appointment types and remained acceptable variables through statistical significance and correlation testing. Many Provider Specialty and E&M code combinations were also attempted. Provider specialties were grouped by those that produced the highest number of RVUs on average and those that were known to have the highest number of encounters. However, the variable proved problematic; as the p -values varied, high VIF scores showed unacceptable multicollinearity in every parameter. Additionally, there were combinations of these two factors that were unacceptable, which made a suitable provider specialty dummy variable unable to be discerned.

E&M codes were grouped into the top 15 most utilized codes, the top cumulative 90 percent of all encounters and other groups delineated by a TK analysis, that were proven to be significantly different from others. The TK analysis showed that all but two E&M codes were predictive; however, inclusion of all E&M codes would not produce a succinct model. Therefore, a TK analysis was performed on the eight most utilized E&M codes (99211, 99212, 99213, 99214, 99395, 99396, 99443, and 99499). This helped to avoid those codes that were deemed highly predictive, but only due to the fact that there were only one or two patient encounters that were coded with that number during the period. Inclusion of such points would have allowed them to have more power within the model than would be prudent. When this combination of E&M codes was placed into the model, the successive TK analysis showed that the addition of another 6 codes would prove the most predictive grouping: 99201, 99202, 99203, 99215, 99397, 99385, and 99386.

The model thus was analyzed for predictive ability, and in combination, the appointment types and E&M dummy variable predicted about 82.47 percent of the variability in Enhanced RVU output, with an adjusted R^2 of 0.83. Taken separately, however, appointment types comprised the vast majority of that predictive ability, producing an adjusted R^2 of 0.82. For the purposes of this study, variables that did not add at least 0.02 percent predictability in the adjusted R^2 were set aside. Thus E&M codes were also set aside. After excluding all other variables, the original variables that were set aside for later analysis (age cohorts, gender, age, BenCats and months) were reassessed and subsequently not added back into the model. These variables ultimately were determined not to be any more predictive when paired with the appointment type variable in the model, as that variable had not been altered from its original condition.

Finally, a Cook's Distance test of influential data points was accomplished. The threshold for residuals of the data points, exerting undue influence on the model in this study is 0.25. The Cook's Distance test indicated no data points that were particularly influential, falling entirely below 0.0014. Figure 7 illustrates this, and that the data points are reasonably uniformly scattered throughout the plot, with many near zero.

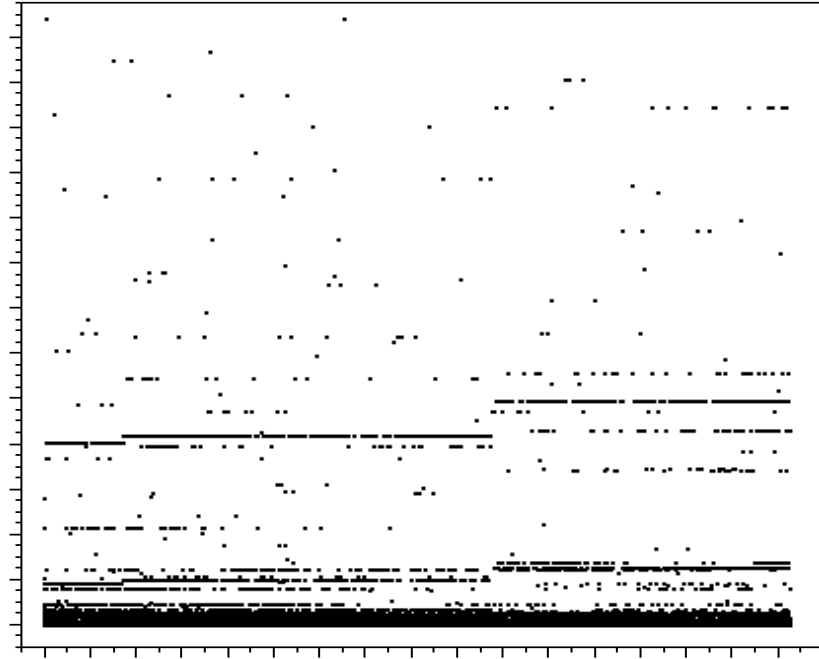


Figure 8. Cook's Distance Overlay Plot

This analysis produced a final model that included all appointment types 1, 3, and 6 as the independent variables:

$$Y_i = 0.883 + 1.383(X_1) - 0.758(X_2)$$

where Y_i are the Enhanced RVU output values, X_1 is Appointment Type 1, and X_2 is Appointment Type 6. The model is interpreted as a per-encounter predictor of the Enhanced RVU output, where X_1 and X_2 will equal 1 if the encounter is coded as that appointment type and 0 if not. A telephone consult produces a RVU amount of the intercept (0.883) only. This would be due to the fact that the other appointment types would be equal to zero, thereby producing no positive or negative effect on the RVU

output for that type of encounter. Stated per encounter, RVU output for each appointment type can be estimated at:

	<u>RVU output</u>
Appt Type 1 (Pre-scheduled)	2.266
Appt Type 3 (Acute, sick-call)	0.883
Appt Type 6 (Telephone Consult)	0.125

Telephone consults add a small RVU output per encounter; however they constitute 72 percent of the total encounters during the period.

Diagnostic Testing

Once establishment of the regression model was complete, tests of statistical significance and of confirmation of the assumptions surrounding the random error in the model were performed. Since the respective p -values were less than 0.00 for each appointment type, this confirmed that the results were statistically significant. Analysis of the residuals for testing normality was accomplished through the KSL non-parametric goodness of fit test. Figure 4-4 shows a good indication that a significant portion of the residual points are not normally distributed. The results of the KSL test for constant variance thus showed a p -value of 0.01, thus indicating that the null hypothesis can be rejected. Independence was verified through the maintenance of acceptable adjusted R^2 values and VIF scores, as detailed above.

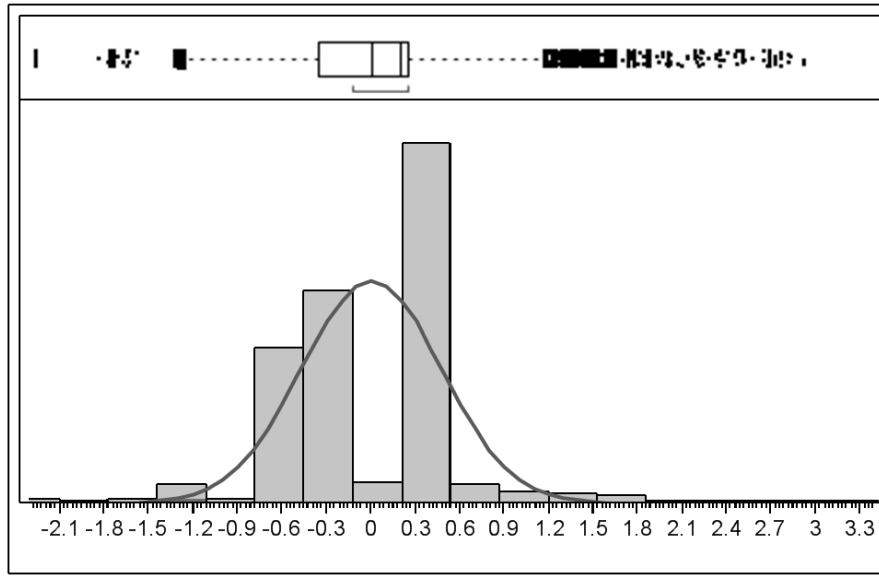


Figure 9. Distributions Residual Enhanced Work RVUs

The Breusch-Pagan test for constant variance showed that the variance is non-constant in this case. Results of the test statistic showed that the value was 3,075.50; an incredibly high number with a desired value of less than 0.05. The SSE was calculated in JMP© as 36,034.81 while the SSR was calculated as 30,645.55. Rather than being mainly indicative of true non-constant variance, the large value is likely attributable to the fact the data set contains such a high number of encounters, n , which directly affects the denominator of the Breusch-Pagan equation. As seen in Figure 9, the variance reduces to small numbers of residual data points, and there is no visual “fanning” effect apparent. Furthermore, the analysis of variance is robust and the quantities of points that lie outside the desired range are small in relation to the total number of data points in this analysis.

Another test was run in order to validate the model, whereby 80 percent of the data was randomly selected to build the model. Using the resulting model, the remaining 20 percent of patient encounters' Enhanced RVU outputs were predicted. The RVU output predictions were compared with a 95 percent mean CI per encounter; all of the predicted Enhanced RVU values were within the 95 percent CI. In this thesis study, all indications were that the null can be rejected in favor of part of the research hypothesis: the per-encounter variable of appointment type shows statistically significant relationships with the output of Enhanced RVUs in primary care.

Summary

This chapter presented a synopsis of the analysis of the variables considered and the results produced in a multiple linear regression equation. Statistical and graphical analysis was shown to aid in determining that a relationship exists between one of those variables and the Enhanced RVU production output. By collecting a robust array of data and not bounding the potential results by inclusion of data points that were grouped into predetermined categories, this study was able to lend clarity and depth to the analysis. Ultimately, a decision was made to reject the null hypothesis. This was possible because of the model's highly predictive adjusted R^2 of 0.82. Stated qualitatively, the appointment types are capable of explaining 82.9 percent of the variability in Enhanced RVU work production output. Finally, this chapter presented a validation of the model's predictive ability within a 95 percent CI, showing that 100 percent of the predicted RVU values fell within this range.

Chapter V. Conclusions

Discussion and Conclusions

This research effort sought to identify the variables that drive efficiency in military health-care. Two concerns were the impetus for this aim: unconstrained health care cost growth and a major reengineering effort in Air Force primary care. A gap in research in this area was identified through the literature review, both in the health care and military realms. The methodology and results chapters presented the analysis and subsequent findings. This chapter presents a review of the research questions and findings, the strengths and limitations of the resulting regression model, and an explanation of the practical implications of the findings. Finally, suggestions for future research and uses of the model are presented.

Research Summary

The purpose of this research was to develop a tool to assist in future efforts to understand and improve efficiency in workload output, as stated in Chapter 1. Specifically, this thesis sought to establish whether a relationship exists between patient workload demand and the per-encounter variables collected at the Wright-Patterson Air Force Base Medical Center (WPAFBMC) Primary Care Clinic. The research questions presented in Chapter I included: (1) What analytic tools and methodologies are currently utilized to analyze and predict production data? (2) Do the per-encounter variables of age, gender, beneficiary category, provider specialty, appointment type, month and E&M code show statistically significant relationships with the output of RVU's in primary

care? (3) What type of variation do these variables impose on work production output (RVUs) in primary care? (4) Which variables are predictive of RVU output? (5) What analytic tools or methodologies could be created to analyze, predict and present cost and production data?

Regression Model

The regression model produced in this study included one variable that showed the most significant relationship with RVU work production output. Appointment Type showed three distinct RVU outputs based on whether the appointment was a prior scheduled appointment (Type 1), same-day scheduled appointment (Type 3), or telephone consult (Type 6). Prior scheduled appointments add 1.383 RVUs to that of appointment type 3 (0.883) and same-day appointments subtract 0.758 RVUs from the intercept. The regression showed that the RVU output from telephone consults should equate to the intercept of 0.883. The totality of this information is consistent, in that each appointment type could be assumed to have its own potential range of RVU outcomes, bounded by the likely series of conditions required for each. Of the appointment types, Prior Scheduled Appointments are the most productive, denoting more labor-intensive care needs. Predictably, same-day or “acute” appointments add a moderate RVU production per encounter. Also unsurprisingly, telephone consults were the least productive appointment type, but remain relevant as they represent a significant 72 percent of the total encounters.

The results of this study differ substantially from that of a previous study on Air Force outpatient RVU production by Moniz (2008). In that study, the specific patient demographics of age, gender, and BenCat were found to be predictive of RVU output in outpatient care. This difference was unexpected; however, it can most likely be explained by the fact this effort was focused on primary care encounters only while the Moniz (2008) study was focused on encounters from all hospital specialty areas. This could point to several additional considerations:

- The primary care population is stable ,with little potential for widely ranging output
- The care itself has evolved
- Those drivers of age, gender and beneficiary category were never applicable to our population's demand for care
- The data collected through M2 in this analysis is not sufficient to show patient demographic-related trends

This could be due to the delivery of care, a different mix of patients and what they are allowed to be seen for or alteration of certain segments of care. The results of this study point to how primary care RVU output is relatively stable in relation to the demographic patient data collected in M2 for this study.

Individually, Provider Specialty and E&M Codes met the model's criteria for inclusion; however, Appointment Type was found to be a far better predictor variable in isolation. Many combinations of the E&M codes and Provider Specialties were attempted individually and in conjunction with Appointment Type, yet none held up under tests of either parsimony or multicollinearity. One combination of E&M codes (99201, 99202, 99203, 99211, 99212, 99213, 99214, 99215, 99395, 99396, 99397,

99385, 99386, 99443, and 99499) categorized as a dummy variable proved to add some measure of predictive ability in moving the adjusted R^2 from 0.82 to 0.83, as well as passing all statistical tests. However, a model that included E&M codes would not have been a useful predictor of RVU output for any period in the future. This is because the patient's E&M code is determined per encounter, and only at the time of the encounter.

In addition, Provider Specialty was nicely predictive of RVU production with a 0.45 adjusted R^2 . This stands to reason, in that the type of provider is related to a specific range of possible RVU outputs, due to their positional capability. Nurses, for instance, showed a significant predictive ability through their p -value of less than 0.001, but with a mean RVU output of only 0.03 per encounter. Many nurse encounters were telephone consults which produced no RVUs: out of 31,841 encounters, 28,871 produce no RVUs (90.67%). Telephone consults may be used to communicate in circumstances not involving an actual patient encounter but which instead convey necessary information between staff members. Therefore, telephone consults may not actually convey accurate information about per-encounter nurse-RVU production. A Nurse Practitioner has a highly predictive p -value as well, at less than 0.001 and an average RVU output of 2.07. Generally each patient encounter produces RVUs; there were only 217 encounters of a total 13,534 that did not produce RVUs (1.60%). Provider Specialty proved problematic in that 11 of 15 categories were predictive. A high level of multicollinearity was thus seen when a Provider Specialty dummy variable was placed in the model with Appointment Types.

While RVU output per month varied widely from 5,897.97 to 14,467.36 as shown in Table 5-1 (varying from the prior month by as much as 43.26%), there were only two

data points for each month of the year (i.e., only 2 years of data). Trend analysis was therefore not fruitful in producing useful or predictive information.

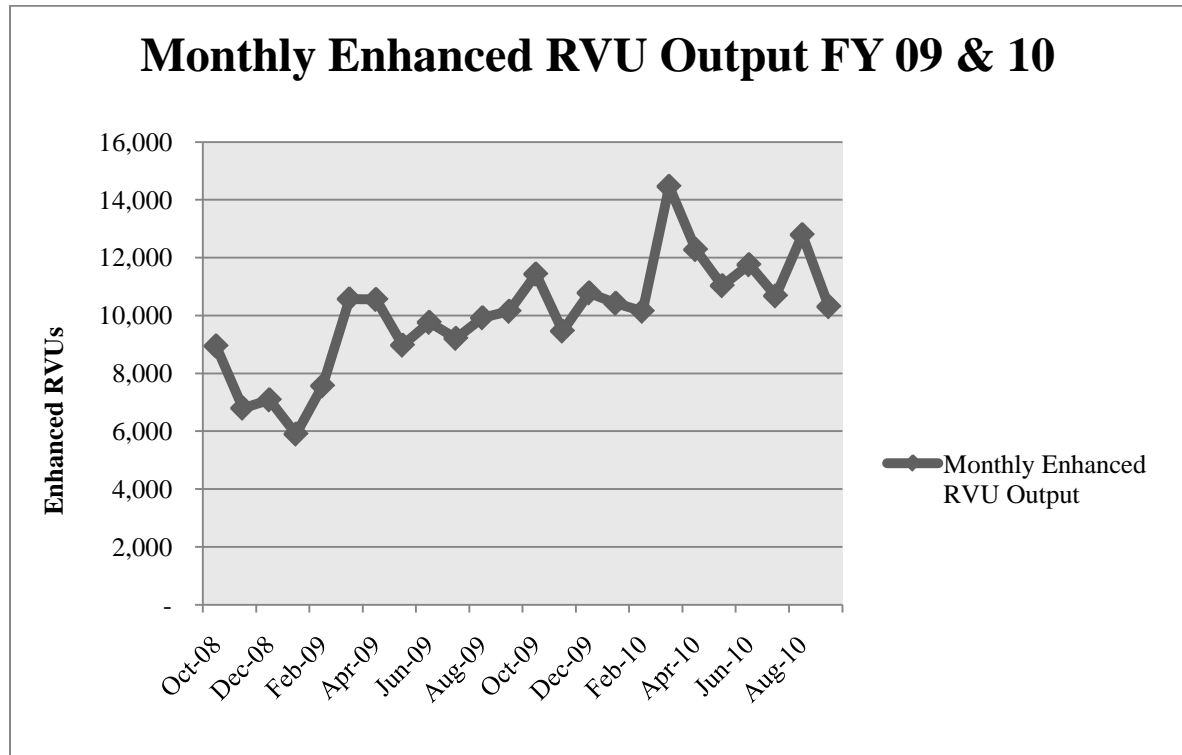


Figure 10. Monthly Enhanced RVU Output FY 2009 & FY 2010.

While the above information addresses research questions 2 through 4, research question five is addressed by the model itself, whereby the regression analysis was completed in order to analyze, predict, and present production data. Because RVUs drive care in the Air Force, and direct costs take a lesser priority to production efficiency, the allocation of funds is driven directly by RVU output. This study showed that RVU output is a function of the underlying patient population's demand for certain Appointment Types.

Model Strengths

One of this model's strengths is its simplicity. By including one variable that is collectively exhaustive, the analysis is sound and the resulting model is useful for uncomplicated predictions of RVU production in primary care. Appointment Types at MTFs are largely controlled by opening the appointment schedule of each provider 30 days in advance. Managers who use this study's regression model as a predictive tool can easily tally the number of open appointments by type and then forecast their expected monthly output. This number should fall within a 95 percent confidence range, which corresponds nicely with AFMOA's requirement that WPAFBMC achieve RVU production in an amount ± 5 percent of the projected capacity.

A second strength of the model is how the demand-based results of this tool can be compared with the capacity calculations provided by AFMOA to better meet RVU production goals. Furthermore, because this model is demand-based, it fills the gap between the capacity calculations utilized historically and the unknown demand of the underlying patient population. Additionally, the Appointment Type is a relatively controllable variable, whereby managers can successfully supply access to care by increasing appointments as required by the FHI mandates. This provides the required flexibility to manipulate the types of appointments to meet output goals.

Model Limitations

This thesis effort addresses some of the limitations of other studies, yet there are areas in which this effort has shortcomings as well. First, the results of this analysis are

only indicative of the underlying population over the period studied at WPAFBMC; they are subject to change and are not necessarily applicable across all Air Force MTFs. Moreover, the data supplied through M2 is assumed to be accurate; however, the data is subject to human error. Second, the data categories pulled from M2 for this study are not all inclusive of the data collected and stored per encounter and could be explored further for predictive usefulness. Third, as discussed in the Regression Model section, nurses use the telephone consult mechanism on many occasions in ways that the other staff do not. Consequently, if these encounters were able to be discerned from the others, telephone consults may provide an even more distinct or wholly different statistical result than what is conveyed by this analysis. As well, very few questionable data entries were found in this study, yet there were some data points missing which could have added value to this analysis. Fourth, this study is limited by the per-encounter data that is collected and reported through the M2 system. The scope of the data could be too limited; patient demographic data may be relevant but unavailable. Fifth, if changes in care practice force RVU production to be altered per Appointment Type, the reliability and predictive efficacy of this model could come into question. Finally, RVU production data were analyzed over a large number of encounters; however, a wider period may allow for seasonal or time trends to emerge as a more useful predictor variable. Monthly predictive ability should be helpful to Air Force health care managers, who plan for and report production metrics on a monthly basis.

Recommendations

To formally address the first thesis question, the WPAFBMC utilizes the same tool AFMOA does to predict and stipulate the MTF's annual RVU output. The tool is constituted based the Unit Manning Document (UMD), which establishes the authorized number of providers for each MTF. This number is not to be confused with the number of actual assigned providers. For example, the Air Force may authorize WPAFBMC to have 20 Family Practice providers relative to the patient population, but may only assign 18. The provider authorizations are linked to a Facility Assignment Code (FAC) specific to each clinic.

While there are several concerns with this method, the most potentially problematic one includes how the actual number of providers is not being considered in these calculations. This is because the UMD rarely reflects the actual number of assigned providers since it does not account for those who leave unexpectedly, are otherwise not seeing patients, or see patients yet do not exist on the manning document. A provider's non-inclusion on the UMD can happen for a number of reasons; perhaps resident physicians are in transition for a longer period or a member has decided to get out of military service. Moreover, specialty providers work in primary care on a per-site basis to meet patient needs based on that MTF's patient population demand, which is also not reflected in the UMD. Because primary care has proven to be a more stable area regarding RVU output, little work has been accomplished in relation to its variability. WPAFBMC expectations are that the RVU production capacity projections will continue to be met, as historically they have been. The Air Force does not utilize the variables that drive care for RVU production output forecasts. If there were to be changes in RVU

output, it would be unclear which variable could hold the power to adjust the output to a more desirable level.

Future Research

The healthcare market and economic conditions have led to new performance requirements that will affect how we deliver care in the near future. While cost growth is a major problem for both the military and civilian sectors, military health care funding is controlled by Congress and reduced budget allocations have become commonplace. Costs do not drive Air Force medical care directly; but efficiency of the resources allocated does. Improving efficiency will require clarity for Air Force leaders to make the best possible choices in moving forward with the FHI project. Clarity in what drives efficiency in primary care was able to be ascertained through the model produced in this study, wherein we can articulate that Appointment Types drive RVU production.

The literature review in Chapter II showed that the new PCMH care trend pulls away from using singularly-priced inputs to care as a measure; however, care will remain driven by RVUs in the DoD for the foreseeable future since the RVU system is utilized in both the DoD and Medicare systems. Air Force health care providers will thus be forced to remain fixed in a system that does not allow for reduction in RVU output, but whose philosophical tenets aim to reduce the amount of care necessary. Furthermore, plans to move the PCMH concept into other specialty care areas, where RVU production is much more wide-ranging, could lead to vast changes in RVU production. As a result, capacity projections may pose a much more varied picture from that of the patient demand.

The stakes are high – where the cost of inaction will most likely mean reduced budget allocations for the Air Force. The number of RVUs expected to be produced through primary care at WPAFBMC in FY 2011 is 66,513.24, or 18.32 percent of the expected capacity total of 363,020.49. Because primary care is such a stable bread winner and is experiencing potentially disruptive changes in production output, it will be increasingly important to monitor and maintain efficiency, especially as access to care, empanelment mandates, and appointment modifications are imposed.

Future Related Subject Areas

Several areas related to the subject matter in this thesis could improve upon the results gained. The Air Force and its sister services could stand to gain a great deal of efficiency insight from studies of the RVU production variance in other specialty care areas, specifically regarding appointment types and patient demographics. Sensitivity analysis could prove useful for planning purposes based on variations in capacity, demand, and any number of the following examples. These are viable scenarios which the expert team involved in this study anticipate would cause production variance, and therefore could benefit from predictive statistical analyses:

- 20% staffing reduction (due to deployments, pregnancies, unexpected loss of staff)
- 10% budget reduction (due to appropriations; happened in FY 2010)
- Enrollment falls by 5-10% (due to discontinuity of dependent care)
- Enrollment increases by 10% (due to Reservist and Guard members coming back from war)

Part of the General Practice Manager's charge is to monitor and manage the mix of patients assigned to each provider. As the patient's level of care needs increase, they require additional effort and resources per visit. The GPMs help ensure no provider is overwhelmed with overly complicated cases while another is underwhelmed with a majority of rather uncomplicated cases. The FHI mandate that each physician and extender see only their team's patients will impose changes to what extent each team's patient mix is managed. Instead of managing a mix of patients for two teams of 10 providers each, where a patient can be placed with any of the 10 team members, WPAFBMC GPMs will have to much more closely monitor the new configuration of 10 teams of one physician and one extender each. This will undoubtedly increase the stakes for ensuring the patient mix for each provider and each team is correct. Further study in this area would help determine if there is an efficient frontier, whereby a specific mix or mixes of providers to patient case-needs is the most productive ideal.

Furthermore, studies would be useful regarding the FHI mandate that patients only see one of the two providers in their assigned team. To increase the likelihood of success, empanelment has been reduced per provider and the number of available appointments has been increased. Historically, patients were placed first with their PCM; if that person were not available, the patient was placed with any provider on the team. However, the teams have been reduced from 10 to 2 providers, and the FHI mandate states that if a patient is unable to be placed with their team, they must be sent outside the MTF instead of being seen by another team. Yet this policy means such a patient would take their potential RVUs elsewhere, thereby increasing the administrative burden and incurring a charge from the outside clinic that otherwise would not have happened. Such

a scenario only serves to increase costs and decrease efficiency. It can be argued that continuity of care is worsened for the patient by forcing them to be seen in a system and by a provider that is unknown to them.

Finally, six additional nurse disease management (DM) positions were authorized for WPAFBMC through the FHI program mandates, based on the MTF's patient population that possesses a disease which requires ongoing management. Study of particular groups of patients, as they relate to nurse DM services, will be necessary in the coming years to better understand the effects the DMs have on patient outcomes and care costs. The DMs could affect RVU output capacity and patient demand; they could also affect the PSM's ability to maintain output efficiency.

Conclusion

This thesis presented a predictive RVU production model showing the impact of each Appointment Type on the final RVU output. The model is a simple and useful tool. RVU output currently drives care because it drives funding allocation in the DoD medical service. RVUs place values on specific aspects of the care rendered. The Air Force is bound to produce a certain number of RVUs annually, with target production ranges calculated through historic averages based per family practice physician FTE. The MTFs produce an estimate of RVU output in their business plan, which mimics the use of AFMOA's FTE capacity model. This imposes a disconnect between Air Force estimates for production capacity and demand imposed by the underlying patient population. Historic studies have shown patient demographics to be the drivers of production;

however, when examining only the primary care clinic, this study showed demographics to be of little predictive value over the period studied. This study showed that Appointment Type is highly predictive of RVU output. The understanding gained through this analysis should improve the ability for MTF managers to predict, manage, and develop their teams' efficiency, thereby aiding in the successful implementation of a robust PCMH program.

Appendix A: AFMOA Production Capacity Model

FY	Pro-duct Line PPS	MEPR3	(A) RVUs per Provider per Day MTF 2008	(B) RVUs per Provider per Day Peer Group 2008	(C) RVUs per Provider per Day Service	(D) Original Avail-able FTE MTF	(E) Origin-al RVUs per Encounter Ratio (A) / (F)	(F) Original Encounters per Provider per Day MTF	(G) Original Annual RVU Production Capacity (A) x (D) x Days per Year	(H) Projected RVUs per Provider per Day MTF	(I) Projected Encounters per Provider per Day MTF	(J) Projected Available FTE MTF	(K) Projected RVU per Encounter Ratio	(L) Projected Annual RVU Production Capacity (H) X (J) X Days per year
2010	PC	BGA	20.19	20.01	13.32	13.870	0.75	27.10	60,478.48	20.18 7	27.10	15.25	0.75	66,513.25
2010	PC	BHA	1.84		13.32		0.84	2.20	0.00	2.024	2.20		0.92	0.00
2011	PC	BGA	20.19	20.01	13.32	13.870	0.75	27.10	60,478.48	20.18 7	27.10	15.25	0.75	66,513.25
2011	PC	BHA	1.84		13.32		0.84	2.20	0.00	2.024	2.20		0.92	0.000
2012	PC	BGA	20.19	20.01	13.32	13.870	0.75	27.10	60,478.48	20.18 7	27.10	15.25	0.75	66,513.25
2012	PC	BHA	1.84		13.32		0.84	2.20	0.00	2.024	2.20		0.92	0.00

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14. ABSTRACT Health care costs have grown to unsustainable levels nationally and within the Department of Defense. Military health care costs have historically been difficult to isolate, causing budget cuts to be the vehicle for cost control. Maximum efficiency, therefore, is the goal in order to show improvement. With the Air Force's new preventive health plan, they aim to drive a long-term posture for cost reduction through prevention. This research effort aimed to develop a tool to assist in future efforts to understand and improve efficiency in workload output, and whether a relationship exists between patient workload demand and the per-encounter variables collected at the Wright-Patterson AFB Medical Center Primary Care Clinic. This study examined primary care production data from the Military Health System Management Analysis and Reporting Tool from fiscal years 2009 and 2010, measuring patient workload in Relative Value Units (RVU) per encounter. The model produced shows a predictive adjusted R ² of 82%, indicating the variable appointment type shows an explanatory capability of the differences in RVU output per encounter and is a demand-based estimating tool for RVU throughput. When applied, the results could lead to a better understanding of efficiency of workload production.					
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